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THE AMERICAN POTASH INSTITUTE
1155 16TH STREET, N. W. WASHINGTON, D. C.

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington, D. C.

VOLUME XXV NUMBER 7

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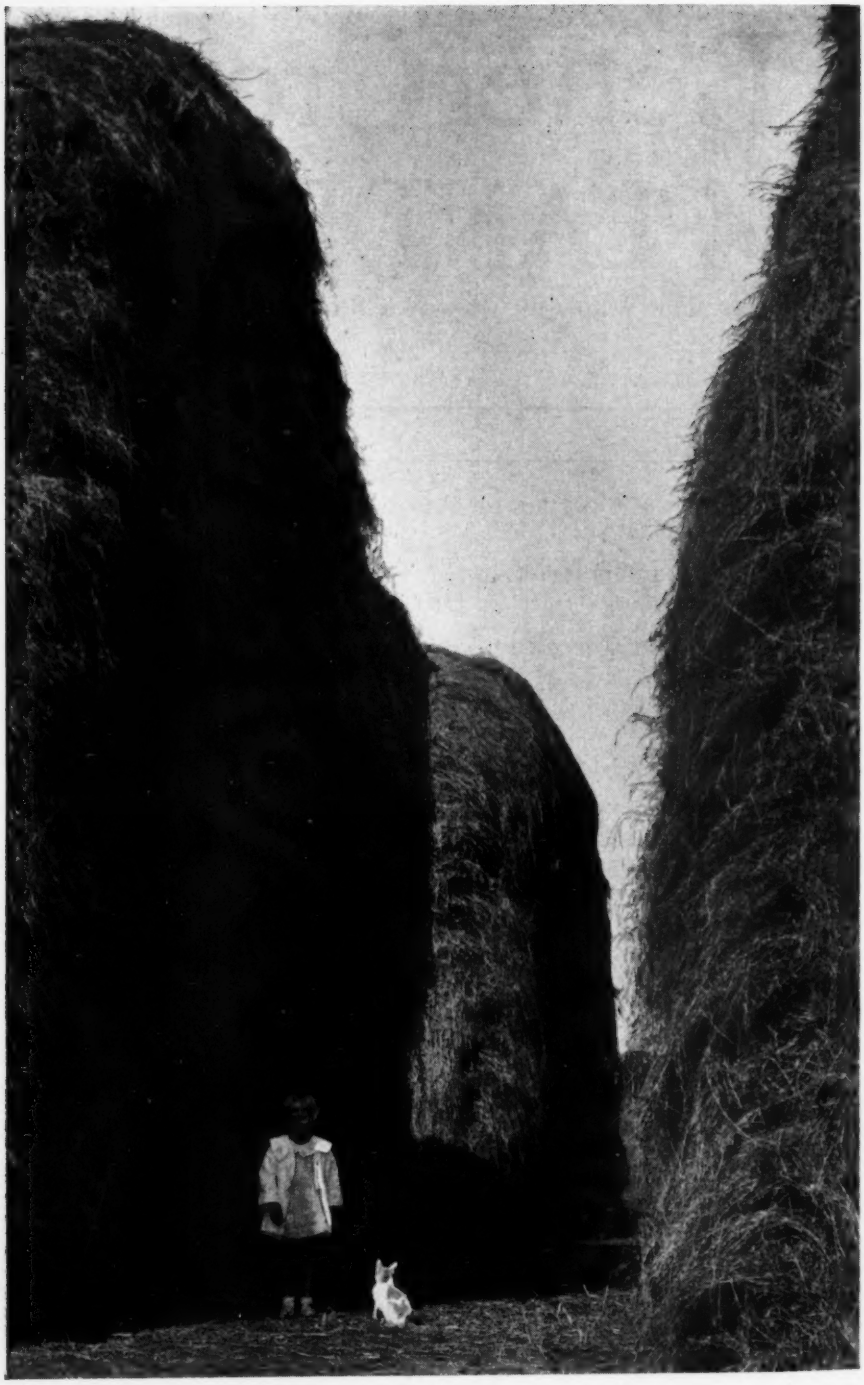

A GOOD "HAY YEAR" RESULTS IN CONSIDERABLE OUTSIDE STORAGE

Better Crops with PLANT FOOD

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VOL. XXV WASHINGTON, D. C., AUG.-SEPT. 1941 No. 7

Home-grown vs. Drug-store. . . .

Vitamins—the V-Sign

Jeff McDermid

IT'S a hot race between government agencies and nutrition specialists to see who confiscates all the alphabet the soonest. All they are apt to leave for us common folks are the X and Z departments, but they'll be handy to cuss with when we begin to pay up.

There's many a new letter added to the list and much confusion about what both government and nutrition mean since that summer day long ago, before World War 1, when the writer had the privilege of composing the first news story on Doc McCollum's rat lab discoveries in fat-soluble A and water-soluble B. That is to say, despite the ease with which politics and science have appropriated our alphabet, we are still far from letter perfect in either field.

It may take some hefty vitamins, ersatz or otherwise, to finish and win the war for somebody; but take it from me, it will require a devilish lot of them to give us the vim, vigor, and vitality sufficient to manage a peace properly when it arrives. And this not alone for the sufferers from bombs and privation, but also for those who will shoulder the job of uniting a battered world for a better kind of living.

To many minds vitamins are what you buy at the drug store that you should have got at the grocery. To kids they simply signify the magic stuff contained in spinach which always bulges Popeye's muscles opportunely. To oldsters they mean curbing rheumatics,

postponing store teeth a little longer, and perhaps restoring dark hair and finding Ponce de Leon's fabled fountain of youth for those who can't sojourn in Florida.

To home ec teachers and extension workers they mean a new angle on old recipes; to druggists vitamins often spell the difference between black ink and red, especially in towns within the goiter belt; and to doctors they afford a harmless substitute for pink candy pills and sugar powders for patients with more imagination than illness.

To high-powered advertising agencies and super salesmen vitamins plugged in everything eatable, drinkable, and chewable provide that last approach to a weary stomach which modern methods dictate.

I doubt very much if Osborne or McCollum and their diligent associates back in the rat-ridden days of small funds and much guesswork could have ever anticipated the diversity of satisfaction, employment, relaxation, hope, and health which the vitamin era has set going. Probably no other practical application of pure science has engendered more lines of activity except the invention of the gasoline and Diesel engines. Lots of it has been bum stuff and poor economics maybe, but that much can also be said of motor mechanics and then some besides.

SOME exclaim that vitamins are just old facts newly proven. Which is true enough; but maybe it's better to know how to make yourself feel good than to just feel good and not know why. Feeling good in past centuries was apparently an accident, due to something folks had "et" without realizing values other than intestinal distention and enhanced pep.

Today vitamins are among the few things left which bind the world together, because their rate of intake is expressed in International Units. It looks as though that form of unity is about all the human family has left. It defies flags and treaties, boundaries, embargoes, arms and oratory.

Fuel oils may be the chief motive of wars, but cod-liver oils are the V-sign in the battle with rickets the world over. It takes strange acids to compound bad medicines of war, but it also requires complex acids to fashion results in the vitamin field. Maladjustment in metabolism probably induces more meanness and quarrelsome habits among human beings than national pride and commercial rivalry. While generals argue over fresh campaigns and we study up new ways to hate each other harder, we behold inquiring scientists smuggling research information back and forth across beleaguered seas. And plenty of that information, thank goodness, has to do with soil balances and vitamin therapy.

I SURE hope the biological chemists and nutrition nurses will keep right on scratching that old V-sign on anything smooth they can locate in this wrinkled world. For you don't have to figure out what word akin to victory it means in anybody's tongue, because all the babies, faded mothers, weak old folks, and starving youths will understand that vitamins spell victory over half the woes which beset mankind and reduce the pressure between the haves and have-nots everywhere.

Certainly in our domestic history there has been a change in both quality and quantity of foods, in some ways better, in others not so good. I recall a grand-aunt of mine whose maidenhood was spent on a pioneer farm, and when we went to her house our diet got a throw-back to deerskin days.

She arose ahead of the fowls and began cooking skillets of oat meal, rashers of bacon, platters of eggs, and plates of corn bread; everything laved in cream and butter, maybe flanked with fresh greens and summer vegetables, and washed down with raw milk and coffee. In season there were fresh fruits and fruit sauces, and we had unrefined molasses on dark bread and apple cider for refreshment.

Of course she belonged to an age when men swung their scythes and

walked behind the plow, cleared lands with axe and mattock, and raised barns by main strength and awkwardness. Her customers of the skillet had the appetite and the outdoors lung power to stimulate internal secretions and digest large and bulky food orders.

It was our lot to be raised in the period just at the turn of the century, before men had become addicted to predigested packaged foods and devitalized victuals. I remember when father

brought home the original paper boxes of "Grainose." We began eating it as a sort of dessert and had to explain to visitors that we were not dyspeptic or inclined to copy the table customs of Battle Creek sanitariums.

Gradually, however, the breakfast table slid over into the hay food category and mothers quit serving us the rich natural fodder of our forefathers. The grocers had to adopt the new methods as the years went by, and bakers refined their breads and pastries to the extreme limits of safety—all being so gradual that few noticed or protested it.

Yet I am not so quick to blame the food fads of other days for all the troublesome defects which have since become a national heritage more or less. It seems to me that our mode of living and our mental processes have created in our bodies a peculiarly favorable ground for these defects to dominate. Naturally we must also recognize such potent causes of bad teeth, poor eyesight, weak tendons, and skin and nerve disorders as ignorance and poverty.

When we can combat ignorance and indifference successfully and give more families a decent margin of income for needful variety in their foods, it will get more vitamins into service. But I still maintain that our post-hasty American way of living and our taut, tense, and irregular behavior are apt to give the vitamins a long fight before they cure us.

It is also a question worth proposing whether the matter of securing rigid patent rights on certain processing and compoundng to restrict the source of vitamins to registered items and groups is going to hold back the wider use of vitamins by underprivileged persons; and if warfare between commodity interests to prevent fortification of rival fats and oils with Vitamin A, for instance, is doing any good to either party, and may work injury to hosts of poor consumers.

IN admiration for past discoveries and with hope for new benefits, I consulted a noted authority on vitamins lately. I glean one statement from his dissertation that should be widely read and carefully noted. This biologist said:

"It is the goal of nutrition workers to make available as rapidly as possible all the knowledge necessary to handle the supply of foods and demand for nutrients in such a way that nutritional deficiencies will disappear. But there are some factors such as habit, economic conditions, ignorance, commercial manipulation of food supplies, and misunderstanding which militate against attainment of this goal."

In connection with physical weakness and debility or poor metabolism, folks often expect a doctor to prescribe diets that will bring rapid recovery, even though the condition was brought about by a prolonged consumption of ill-balanced rations. If on the other hand a fellow thinks he can dose himself with vitamins and depends on some knowing young sandwich hound in a drugstore to set him right on nutrition, he

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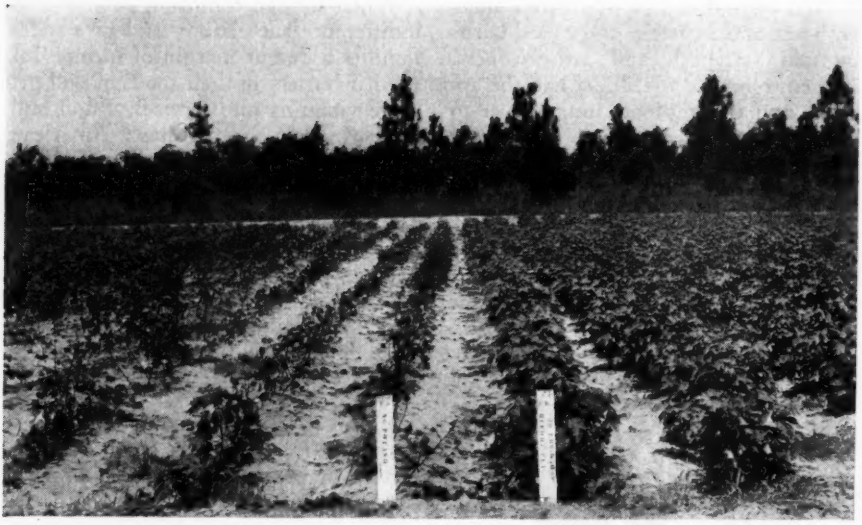

Fig. 1. Cotton plot on the left received no potash while plot on the right received a 30-pound application of K_2O. Note the open bolls and loss of foliage on the no-potash plot.

Cotton and Corn Response to Potash in South Carolina

By G. B. Killinger

Agricultural Experiment Station, Clemson, South Carolina

THE fertilizer industry, soil scientists, agriculturists, and men interested in crops and soil problems have recognized the importance of a balanced plant-food content in the soil. Many complications come to light, however, when any single element or combination of elements is studied. When certain of the necessary nutrients are added to a soil, physical, chemical, and biological action may convert, combine, or change these nutrients to unavailable forms, causing plants to suffer what might be termed malnutrition. The same nutrients may be added to another soil with excellent results, as exhibited by normal plant development.

Certain deficiencies of plants have come to be recognized by foliar diagnosis. Potassium or potash hunger in cotton plants is quite readily recognized and has often been referred to as brown rust. The advanced stages of this rust may find the plant completely defoliated before maturity. The cotton bolls may not be properly developed and often fail to open properly at harvest time, accounting for a high percentage

of cracked bolls. Figure 1 illustrates a plot which has received 30 pounds of K_2O per acre, while the adjacent plot received none. Note the open bolls and lack of foliage in the no-potash plot.

In South Carolina there are considerable acres of cultivatable soils, such as sands and light sandy loams with pervious subsoils, which are often very low in available potassium as well as in total potassium. Such soils as these give the most striking response to potassic fertilizer materials.

The Southern and Southeastern States have a farm management record showing large areas continually cropped to potash-depleting crops, such as cotton, oats, corn, tobacco, and legumes, with other miscellaneous crops to a lesser extent. These crops utilize or take from the soil large quantities of potassium when calculated over a period of years. The utilization of potassium as the oxide by some crops has been shown by Van Slyke (8) and others.

It is generally recognized that leguminous crops such as alfalfa, lespedeza, clover, soybeans, cowpeas, etc., require more potash than non-leguminous crops. During the past decade Southern farmers have greatly increased their acreage of these crops, many of which are taken from the land and utilized as feed. With this situation existing, it is no wonder that serious potash deficiency conditions have developed.

As shown by Truog (7) about 160 pounds of readily available potassium per acre are needed for the production

TABLE 1.—AVERAGE YIELD IN POUNDS OF SEED COTTON PER ACRE FROM EXPERIMENTS ON RATE AND TIME OF APPLYING POTASH TO COTTON

(The Averages for Each Treatment Are from Eight Years' Results)

Pounds of potash applied	Time of application	Average	Average for each rate	Per Cent increase over no potash	Increase of seed cotton for each lb. of potash
None		792	792	....	....
15	All before planting	1001	1010	27.5	14.5
	½ before planting, ½ at chopping	995			
	All at chopping	1035			
30	All before planting (Check Plats)	1201	1136	43.4	11.5
	All before planting	1145			
	½ before planting, ½ at chopping	1126			
	All at chopping	1072			
45	All before planting	1216	1192	50.5	8.9
	½ before planting, ½ at chopping	1215			
	All at chopping	1146			
60	All before planting	1272	1275	61.0	8.0
	½ before planting, ½ at chopping	1287			
	All at chopping	1266			
75	All before planting	1319	1319	66.5	7.0
	½ before planting, ½ at chopping	1344			
	All at chopping	1294			

of normal yields of alfalfa, corn, and cereals.

Attention has been called to great variation in the availability of potassium in different soil types by Bryan (2). It is not necessary to have as high a level of potassium in the Coastal Plains sandy soils, as in the Corn Belt soils. Potash in sands is considered relatively highly available, while in clays the reverse may be true.

Response of cotton to potash on some South Carolina soils is pointed out by Killinger (3). He states that a profitable response has been noted when potash in addition to that already used in ordinary commercial fertilizers is applied to many soils in South Carolina.

Pate and Skinner (4), Skinner (5), and Skinner and Pate (6) found on a number of Coastal Plains and Piedmont soils that potash gave increased yields of cotton, while without the use of adequate potash the cotton was considered a failure on some soils. The sources of potassium in mixtures with phosphoric acid and nitrogen failed to show any wide variations in yield of seed cotton.

Cooper, Schreiner, and Brown (1) recognized that available potash increases the resistance of many crops to disease and that certain diseases of the cotton plant vanished upon the application of potash. These scientists state further that, without potash, or with too small an amount of it, profitable cotton production is practically hopeless, this being particularly true of the general run of cotton soils in the Southeastern States.

Results of Experiments

Experiments have been conducted in South Carolina for a number of years to determine the optimum rate and time of applying potash to cotton and the rate most profitable for corn. These tests were conducted in every part of the State on many different soil types.

Experiments with cotton were conducted using duplicate 1/20-acre plots for each treatment with a check plot bordering every treatment, which allowed for approximately 2/3 of the experiment to be in various treatments and 1/3 in checks. All plots in the tests received the equivalent of 600 pounds of a 5–10–0 fertilizer per acre, and the check plots were treated with a 5–10–5 before planting. The potash applied, both as to rate and time, varied as outlined in Table 1. None to 75 pounds per acre of K_2O were used with 15-pound increments. All plots received an additional 15 pounds of nitrogen from cal-nitro at side-dressing time. The nitrogen in the fertilizer mixture was derived 1/2 from cottonseed meal and 1/2 from ammonium sulfate. The phosphorus was from superphosphate and the potassium from muriate of potash. Dolomitic limestone was applied to all plots in the row at the rate of 200 pounds per acre.

The average of eight years' results from 84 to 137 plots exclusive of checks shown in Table 1 indicates a profitable response from all rates. A 66.5 per cent increase in seed cotton is noted from the use of 75 pounds of K_2O over no potash. The greatest returns per pound of potash are found from the smaller applications. Foliar deficiency symptoms could be noted in some cases with light treatments, while with the higher rates these deficiencies disappeared. The time of application apparently had little effect on the final yield. Some beneficial effect was noted from the lower rates of potash with delayed application, while with higher applications, all the potash applied before planting or 1/2 at planting and 1/2 at chopping time gave slightly the highest yield.

In determining the potash requirements for corn in South Carolina, the soils were divided into the Mountain and Coastal Plains groups. Figures 2 and 3 show the response of corn on plots receiving no potash and 30 pounds per acre, respectively, at the Sandhill Experiment Station. The Mountain soils used were of the Congaree or Toxaway series while the Coastal Plains soils were largely Norfolk, Marlboro, Ruston, and Orangeburg. One-twenti-

Fig. 2. Check plots in potash experiments with corn received 30 pounds of K_2O per acre.

Fig. 3. Adjacent no-potash plot in same experiment.

eth-acre plots, with a check plot beside each treatment, were used throughout these experiments, and the entire plot of each treatment was harvested for yield. Cal-nitro was used as the sole source of nitrogen, superphosphate for the phosphoric acid, and muriate of potash for the potassium oxide. Several additional plots were added to the experiment to indicate the importance of nitrogen and phosphorus; however, the phosphorus set-up was not complete due to the lack of no-phosphorus plots. This factor has been corrected for future experiments. All the fertilizer was applied at side-dressing time to the Mountain soils when the corn was

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The Effect of Borax on Spinach and Sugar Beets[1]

By R. L. Cook and C. E. Millar[2]

THE use of boron in relation to plant growth has become a subject of intensive study throughout the world in recent years. Much has been written regarding the crop response which may be expected from applying boron to natural soils and to sand and water cultures.

Symptoms of boron starvation have been described by various authors for a variety of crops. The writers have grown 27 different crops in greenhouse pot cultures or in field experiments in an attempt to acquaint themselves with symptoms of boron deficiency. To date the symptoms exhibited by sugar beets (3)*, canning beets (5), mangels, chicory, alfalfa, and clover (4) have proved to be most valuable in making recommendations for the application of borax on Michigan soils.

Some few investigators have concerned themselves with the role of boron in plant growth and with the influence which boron may have on the passage of other ions into the roots of growing plants. Schmidt (12) found nitrate assimilation to be increased in sugar beets and barley which were starving for boron. He believes the physiological breakdown of the plant tissue to be due to a toxic concentration of nitrate nitrogen.

In their most recent review of the literature on the function of boron in the plant, Dennis and Dennis (7) cited eight publications in which the investigators reported that boron starvation was accompanied by an increase in content of nitrogen in the plant and two publications in which the opposite was the case. In two publications the writers reported increases in the calcium and phosphorus content and a decrease in the potassium content of boron-starved plants.

Dmitriev (8) found that borax applied for clover lowered the percentage of ash, total nitrogen, and phosphorus in the plant, but did not affect calcium content. Joret and Malterre (10), on the other hand, found that 15 kg. of $Na_2B_4O_7$ added to normal complete fertilizer increased the percentage of nitrogen and potassium but lowered that of phosphorus in sugar beet roots and tops.

Some investigators have maintained that boron does not function within the plant but in the nutrient medium, thereby affecting the intake of nutrients. Maier (11) claims to have disproved this theory by applying boron to the above-ground parts of plants and thereby preventing the appearance of boron deficiency symptoms.

It is the purpose of this paper to present the results of field and greenhouse experiments which may furnish more evidence of the need of certain crops for boron and to present analytical data which may be useful in studying the functions of boron in plants.

Sugar beets were grown on Wisner silt loam, a soil containing free carbon-

This article appeared also in Proceedings, Soil Science Society of America, Vol. 5, 1940.

[1] Contribution from the Soils Section, Michigan Experiment Station, East Lansing, Michigan. Authorized for publication by the Director as Journal Article No. 499 n.s. of the Michigan Agricultural Experiment Station.

[2] Research Assistant in Soils and Head of Soils Section, respectively.

* Figures in parenthesis refer to "Literature Cited," p. 42.

ates at the surface but less organic matter than is found in Thomas sandy loam. In this experiment borax was applied as a side-dressing on June 20, after the beets were blocked. Application was made with a hand drill at rates of 20 and 40 pounds per acre. The borax in each case was mixed with 150 pounds of 2-12-6 fertilizer. The plats which served as the controls received the 2-12-6 fertilizer without added borax.

Spinach was grown on Thomas sandy loam, a soil containing free carbonates at the surface and from 14 to 18 per cent organic matter in different parts of the field. Borax was applied in the basic fertilizer mixture at rates of 0, 10, 20, 40, and 80 pounds per acre. All fertilizers were broadcast and worked into the soil immediately before the spinach was planted. The basic fertilizer consisted of the following materials at the rates per acre indicated: 3-12-12, 500 pounds; NaI, 0.5 pounds; $ZnSO_4$, 4.0 pounds; $MgSO_4$, 25.0 pounds; $MnSO_4$, 25.0 pounds; $FeSO_4$, 2.0 pounds; NaCl, 10.0 pounds; and $CuSO_4$, 5.0 pounds. One treatment included only the 3-12-12 fertilizer. Treatments were replicated five times and were arranged in randomized blocks. Spinach was planted on May 5 and harvested on July 6.

Samples of both spinach and sugar beets were saved for analysis at the time of harvest. The spinach tissue, roots and tops separately, was analyzed for its content of boron, nitrogen, iron, calcium, and magnesium. The sugar beet tissue, roots only, was tested for its content of sucrose, boron, nitrogen, and iron. Analytical methods are described below.

Experiment Set Up

As several investigators had reported a relationship between the boron and nitrogen contents of plants, an experiment was set up to study the effect of varying nitrate levels in the soil on the yields, appearance, and composition of sugar beets when grown on a soil deficient in boron and on the same soil after treatment with borax.

Twenty-seven 1-gallon glazed earthenware jars were filled with Thomas

Fig. 1. Sugar beets grown on Wisner silt loam soil. Of the two left piles, grown on a plat which did not receive borax, the larger one contains the beets which showed heart rot symptoms, while the smaller one contains the normal beets. The two right-hand piles were grown on a plat which received 20 pounds of borax per acre. The larger pile contains the normal beets and the smaller one the beets which have heart rot. Note the increase in percentage of normal beets as a result of the borax treatment.

sandy loam soil known to be deficient in boron for sugar beets. A nutrient solution containing sufficient quantities of phosphorus, potassium, magnesium, calcium, manganese, aluminum, iodine, copper, and zinc was applied to all jars. They were then divided into three lots of nine each. One lot was left without borax, one received borax at the rate of 10 pounds per acre, and the other at the rate of 20 pounds per acre. Next, each lot of nine jars was divided into groups of three, one group received no nitrogen, one was treated with NH_4NO_3 equivalent to 95 pounds of NO_3 per acre, and the other with NH_4NO_3 equivalent to 190 pounds of NO_3 per acre.

Three beet plants were transplanted into each jar on March 25. Moisture was maintained at a fairly constant level by frequent weighings and additions of distilled water. Harvest was made on June 17.

The plant tissue analyses reported in this paper were made on tissue dried at 65°C and ground to pass a 1-mm. sieve.

Boron was determined by the Berger-Truog (1) method. Calcium and magnesium were determined from the ash, calcium as the oxalate by titrating with standard permanganate solution, and magnesium by the gravimetric pyrophosphate method.

Iron was determined by titrating the ferric ion with standard titanium trichloride solution. Total nitrogen was determined by the Kjeldahl method. Sucrose was measured in the juice of sugar beets by means of a saccharimeter.

When sugar beets are starved for boron, they suffer certain physiological disturbances which have been termed heart rot. As the symptoms of heart rot have been previously described (3) they will not be repeated here.

According to the data reported in Table 1, 96.86 per cent of the sugar beets grown on Wisner silt loam soil and not side-dressed with borax developed symptoms of heart rot. An application of 20 pounds of borax reduced the occurrence of the symptoms to 11.36 per cent. With an application of 40 pounds of borax the occurrence was further reduced to 4.65 per cent. The piles of beets shown in Fig. 1 illustrate this increase in percentage of normal beets as a result of the application of 20 pounds of borax per acre. The appearance of the beets before harvest is

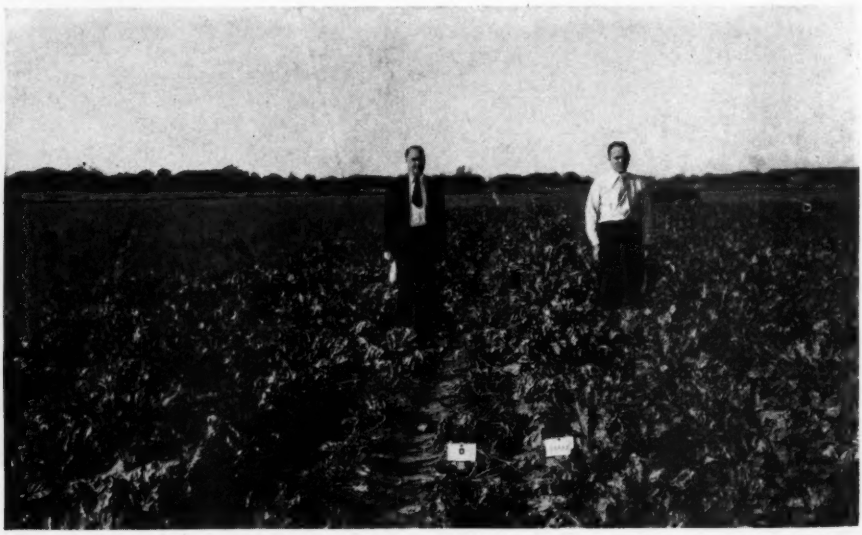

Fig. 2. Sugar beets on Wisner silt loam soil. Two rows in left center received no borax. The rows at the right received 20 pounds of borax per acre as a side-dressing after the beets were blocked.

Fig. 3. A close-up of the rows shown in Fig. 2. Note the dead tops on the plants not treated with borax and the healthy tops on those which received borax. The picture was taken on September 17.

shown in Figs. 2 and 3. Note that practically all of the plants in the untreated rows were affected.

The yield of sugar beets was increased from 7.16 tons per acre where borax was not applied to 14.30 and 14.78 tons, respectively, where applications of 20 to 40 pounds of borax were made. The difference between the yield resulting from 20 pounds of borax and that from 40 pounds was not significant. As indicated by the weight per individual root, the increase in yield as a result of the borax applied was mostly accounted for by the size of the beets. This may appear contrary to some reports that symptoms of heart rot occur more often in the larger beets. The latter may be the case on a soil where a deficiency of boron is not acute, but on a soil such as the one in question available boron is at such a low level

TABLE 1. THE EFFECT OF BORAX ON OCCURRENCE OF HEART ROT, YIELD, SIZE OF ROOTS, SUCROSE CONTENT, AND PURITY OF SUGAR BEETS GROWN ON WISNER SILT LOAM SOIL IN 1940

Treatment [1]	Roots with heart rot	Yield per acre	Individual root weight	Sucrose content	Coefficient of apparent purity	Substances in solution other than sugar
	Per cent	*Tons*	*Pounds*	*Per cent*	*Per cent*	*Per cent*
No borax	96.86	7.16	0.93	14.11	80.92	3.31
Borax 20 lb. per A.	11.36	14.30	1.79	18.02	84.91	3.19
Borax 40 lb. per A.	4.65	14.78	1.94	18.45	85.97	3.02
F value	585.41**	92.14**	91.46**	20.43**	7.80*	1.62
Required for significance	7.34	1.54	0.63	1.83	2.84	0.64

[1] Borax applied as a side-dressing on June 20 after the beets were blocked.
* Significant to 5% point.
** Significant to 1% point.

that growth is stopped while the beet is still small.

There were no differences in stand as a result of the borax treatment on this soil. This result was to be expected as boron starvation does not become apparent until after midsummer. Presumably, the supply of available boron in the soil is sufficient for the beets during their early growth. Plants, therefore, do not die from heart rot as they do from such diseases as black root. Borax applied as a side-dressing would not be expected to prove toxic and would thus have no effect on stand. Size of beet is then the only source of increased yields.

Sucrose Content Important

One of the most important problems in the production of beet sugar is the sucrose content of the beets. Any treatment which increases the percentage of sucrose as well as the yield of beets per acre is therefore doubly valuable. Further reference to Table 1 shows that roots not side-dressed with borax contained only 14.11 per cent sucrose as compared to 18.02 and 18.45 per cent, respectively, in beets from areas which received 20 and 40 pounds of borax per acre. This means 2,021 pounds of sugar per acre from the areas not treated as compared with a production of 5,154 pounds on the areas side-dressed with 20 pounds of borax and 5,454 pounds on the areas which received 40 pounds of borax per acre.

The difference in yield of sugar from the areas treated with 20 and 40 pounds of borax, although not large enough to be significant, is an indication that even slight benefits from borax may be accompanied by an increase in percentage of sugar and in yield of sugar per acre. This was further indicated by sugar determinations made on beets which showed only leaf symptoms of heart rot and on some which had root symptoms as well. It is assumed that leaf symptoms as a rule appear before root symptoms and therefore indicate an early stage in boron starvation. One would expect the percentage of sucrose to be higher in beets where a shortage of boron had recently appeared than in those roots where the shortage had been serious for some time. Such was found to be the case. Roots from plants with leaf symptoms contained 14.84 per cent sucrose as compared with a percentage of 13.21 in roots from plants which showed both leaf and root symptoms.

This tendency for sucrose content to depend upon the degree of injury from boron starvation might be taken as an indication that on fields where the level of available boron had fallen just to the point of appearance of symptoms, but where symptoms had not yet occurred, sucrose percentage might be slightly increased by an application of borax on beets which never would have exhibited symptoms of boron starvation. Such an increase, however, would no doubt remain within the range of experimental error, so it could not be shown by analyses.

Coefficient of apparent purity is a figure which represents the ratio between the sucrose in solution in the juice and total soluble substances in the juice. The application of borax resulted in a significant increase in this coefficient (Table 1). There are two factors which may cause this coefficient to increase. If the percentage of sucrose increased, the ratio between sucrose and all substances in solution would, of course, increase. A further increase would be obtained, however, if the substances other than sucrose should become less. Both of these factors appeared to play a part in the data reported. While the difference in sucrose content played the major role in raising the purity coefficients, the data reported in the last column of Table 1 show that borax did have a tendency to cause a decrease in the soluble substances other than sucrose.

It is known that besides the sucrose, the soluble substances in sugar beet juice are mostly nitrogenous compounds. A decrease in soluble nitrogenous substances would then indicate that borax was effective in reducing

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Good Farming By Good Neighbors

By M. E. McCollam

San Jose, California

THIRTY-FIVE years ago a lad was being brought up on the California grain and hay farm of the Peukert family, then located at and around the present site of Fremont High School in the metropolitan area of Los Angeles. Not far away a youngster six years old left the Anaheim, California, home of the Arrougé family where he was born, and went on a journey to Southern France for his schooling and early farm experience. At the age of 18 he came back to Anaheim and then dairy farmed for 14 years in California's Imperial Valley.

Sixteen years ago these two men, Peukert and Arrougé, converged finally on neighboring farms in Ventura County near Oxnard, California. They

Mr. Peukert with a specimen of his sugar beets.

Mr. Arrougé with a specimen of his 1940 pepper crop.

both knew the trouble that had to be "licked"—white alkali land that yielded only about three tons of sugar beets and one sack of lima beans per acre. This kind of trouble was multiplied 60 times for Arrougé; he had 60 acres. Peukert was "in" even deeper; he had 112 acres.

Both men had very sound farming experience and believed in some very fundamental soil practices. Aside from this, however, one of their most important ideas was that neighbors can begin their cooperation at home and thereby operate their farms cheaply and efficiently. They demonstrate this by often buying a piece of machinery together, and they figure out their operations so that crops on the two farms can be worked as units. According to

these men, it is a big timesaver to work the same machine on both farms during the same period. Their labor is exchanged freely, and there is but little need for extra labor except during harvest.

But let's get back to that alkali land of some years ago. The first thing emphasized was leveling the land. This leveling was perfectly done, and the land has been constantly leveled to keep it that way ever since. Windbreaks of eucalyptus and cypress were planted to warm up the soil and prevent wind damage.

Drainge, of prime importance on alkali land, was next given consideration, and tile lines were laid 200 feet apart at a depth of 7 to 8 feet. By means of this drainage and by subsoiling, which has since been done every three or four years, the salt was decreased, crops began to look better, and yields increased each successive year.

Then crop rotation, cover crops, and fertilizers engaged the attention of these neighbors, and they launched upon a program of soil building. Their rotation includes lima beans, peppers, and sugar beets arranged in a 4-year rotation plan. The large lima beans are planted after a cover crop of barley, planted the previous winter, is plowed under. Usually about 400 to 500 pounds of cyanamid or other nitrogen fertilizer to supply about 100 pounds of nitrogen per acre are applied and plowed under with the cover crop. This treatment plus an irrigation following help the soil to assimilate the organic matter. The beans are given one good irrigation in July, which is sufficient. Marketing of the crop is handled by a growers association which, in their opinion, is the most practical method for securing best prices. All bean-straw residue is plowed back into the soil. Mr. Arrougé sometimes grows Fordbook limas for seed, as his bean crop. Last year these brought him nine cents per pound.

Harvesting a pepper crop of six tons per acre.

Peppers follow the beans in the rotation and are grown for canners under contract for $32.50 per ton. In order to make money on peppers, there must be a high yield per acre and a small percentage of culls. Mr. Peukert says that this crop needs plenty of available plant food in the form of complete fer-

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Dairy cattle on pasture—summer 1940. This pasture was developed from land badly eroded in 1906.

Better Pastures for North Mississippi

By E. B. Ferris

Holly Springs Branch Experiment Station, Holly Springs, Mississippi

PERHAPS never before in the history of Mississippi has more attention been given to the improvement of pastures. In a pasture symposium held by experiment station workers at State College, not only all station employees attended, and the specialists among them took part, but two of the best pasture experts of the Nation led in the discussions and added much to the interest thereof, especially in presenting the best known pasture research methods. Pasture problems are by no means new to the country as a whole, but until recently in Mississippi had been overshadowed by the importance of other work which at least for the time seemed to have a greater dollar and cent value to the farmers; although it is extremely doubtful if any phase of farming, past, present, or future, has held greater opportunities for profit to the landowner than the development of first-class pastures.

It was brought out at this symposium that leading thinkers as many as 100 years ago had seen the need for just such information, and certainly since the establishment of the Agricultural and Mechanical College at Starkville in 1878, the best thinkers connected with it have stressed the importance of such work. The writer's first experience as a student at Starkville was in the fall of 1892, more than 48 years ago, when the professor of agriculture took our class to the dairy farm of Colonel W. B. Montgomery, local trustee of this insti-

tution since its establishment, then past 70, and better known as the "Jersey King of the South." Colonel Montgomery's advice to us, as the possible future farm leaders of the State, was to stop trying to kill grass as had been our custom as cotton producers, and make an equal effort to encourage it to grow. He told how for years he had tried out every new grass and clover he had thought capable of growing and reproducing without petting, and how later he had come to taking seed of the more persistent kinds with him as he rode over his pastures, sowing a little here and there, and afterward observing the way they reproduced and afforded forage for his cattle.

Changed Farm Practices

As measured by the methods of today, this may seem quite crude, but his efforts in a little less than half a century have revolutionized the farm practices of the several counties nearby having a somewhat similar type of soil, by changing them from entire dependence on cotton as a money crop to gradually making the grazing of beef and dairy animals the predominant use to which such lands are placed. We shall never forget a word of advice then given by him that in our future efforts to improve farm conditions we should throw away our plows, indicating that he thought disturbance of the land by too much plowing was bad, both for vegetation and for the future control of erosion.

We have since reflected much on the wisdom of his remarks, and while at first regarding them as the expression of one over-enthusiastic about his own interest, have gradually come to regard his advice as coming from one endowed with the gift of prescience. As the study of land protection and preservation, especially against erosion, has increased in recent years, we find the ideas of the ones who have given most thought to it coming more and more into conformity with the advice of this old gentleman who, in more ways than one, gave evidence of his ability to think far in advance of his generation. The lands around Starkville were not of a very erosive nature, nothing to compare with several other soil types of the State. If his advice to his neighbors has been worth so much in preserving and improving the heavier soils of East Mississippi, what would it have been worth if it similarly had been put into effect on the lands of Northwest Mississippi with which we are presently concerned?

Reclamation Started

Surely in no other part of the State would such advice have been worth more, if heeded, than on the lands of Marshall County, typical of thousands of square miles of territory in North Mississippi and West Tennessee where thin layers of loamy surface soils are superimposed on much thicker layers of almost pure sand. The loams themselves are possibly no more erosive than other soil types of the country, but when moving water once washes through these loams and reaches the sand beneath, as expressed by Professor W. L. Hutchinson nearly 50 years ago, these lands "Melt like sugar and slide like hell." So, some 35 years ago, when Professor Hutchinson, as director of all Mississippi experiment stations, and C. T. Ames, as superintendent of the newly established branch station at Holly Springs, took charge of one of the worst eroded farms in North Mississippi, they set to work not only to reclaim and hold such soils against future erosion but at the same time to profitably utilize them for grazing.

The writer came into the picture much later and after most of the work of reclamation had taken place but has had, nevertheless, a good opportunity for observing what may be done with such eroded soils, once worse than worthless, because, like an infectious disease, they contaminate adjacent areas. Thus the sands from a single gully system near Holly Springs are said to have covered more than 600 acres of good bottom land below so deep in sand as to make it worthless for future

profitable cultivation. Fortunately for those who were later to study these problems, pictures were made of many of the eroded spots on the station farm before and after treatment so that one may now see with the eye what they looked like before the hand of a man like Charlie Ames filled the gullies, terraced the land, and stopped the frequent use of plows, letting pasture sod bind the soil and gradually develop profitable grazing.

Erosion Control Not Enough

But simply to stop this erosion and get the grasses and clovers started is not enough for most profitable results, for even the naturally productive surface loams, still in place, need additional plant food and need it all the more after much inert sand has been mixed with these loams in the process of filling the washes and leveling the land. Perhaps such reclaimed lands will never produce the pasture forage they might once have produced and perhaps the cost has been more than the land at the time was worth in dollars and cents. This the Federal Government has since recognized and is now making every effort to assist local owners to terrace their lands, plant soil-binding crops, and gradually remove the menace of the free movement of surface water. They are doing this by helping to supply trees, kudzu plants, serecia lespedeza seed, bermuda, and at the same time minerals to hasten their growth.

In 1937 a large number of plots were laid out in pastures at the Holly Springs station where many different fertilizer combinations have since been used to determine the response of such soils to the different plant nutrients. The immediate results of such tests were to show the good effects from minerals applied to such soils, not only in the increased production of pasture forage, but also in the higher percentage of proteins, fats, and minerals contained in the forage itself. The latter was due, no doubt, to the minerals having encouraged a greater growth of legumes, for the fertilizers were used on pastures already set to a combination of grasses and legumes. Light applications of lime have proved helpful.

Just how best to measure pasture results will depend on circumstances. Possibly no method can approach the

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Badly washed land, similar to ones reclaimed at Holly Springs and shown in pasture pictures—summer 1940.

Organic Matter

Conceptions and Misconceptions

By Ford S. Prince

Agricultural Experiment Station, Durham, New Hampshire

MEMBERS of the Agricultural Profession are often criticized for their failure to make statements that are definite and specific. At least I am. In fact, my wife told me recently that she was rather sick of agricultural talks because the three principal words were if, but, and maybe.

Of course, I tried to argue with her by saying that agriculture, unlike mathematics, is a very, very young science and that when we have been figuring things out scientifically in the farming game as long as scholars have been devising devious mathematical formulas, we will be able to nail the facts to the barrel head in better shape. This was a poor explanation for her since her mathematical education hesitated at the multiplication table of twos, and she said so. And there are a great many people who feel as she does, especially if they have had less training in and association with people in agriculture and do not appreciate the vagaries of rainfall, climate, and more especially, the complex nature and functions of the soil itself.

Take soil organic matter as an example. Farmers have long recognized its worth as a soil-building component, for the application of farm manure is one of the oldest methods of soil improvement. Many writers have stated that there is a fairly direct relationship between organic matter and the nitrogen it contains and soil productivity. Yet, what rotations and cropping practices will maintain the organic matter supply of the soil? What is the relationship between organic matter depletion and soil erosion? Once depleted, how can organic matter be most quickly restored to the soil? Is it possible to greatly increase the normal supply of this substance in the soil? What is the relationship between the application of fertilizers and lime to organic matter maintenance? Why is a goodly supply necessary for soil productivity? These and many other similar questions now demand an answer in the face of the fact that our soils are wearing out and washing away and have been doing so at an accelerated rate for many years.

It is only recently that some of these questions have been answered by soil scientists. Others are doubtless in the process of solution. But it is quite apparent that the whole subject has not received enough study by research men up to the moment, and if we are to take more of the "ifs" and "buts" out of the organic matter story, more work will need to be done.

Short Rotation Tried

We started out very blithely in New Hampshire a dozen years ago by undertaking to produce potatoes in a three-year rotation with oats, and one year of clover and timothy hay. The oat crop was removed as grain or hay and the first hay crop was taken off in the hay year but the second crop was plowed under, much to the disgust of the dairymen living near the farms on which the experiments were located. At that time a three-year rotation was considerably shorter than those usually practiced with potatoes in New Hampshire.

Good hay and oat crops were produced, and there was abundant stubble and second crop to plow down as organic residue. We confidently expected that such a system would maintain the organic matter of the soil and that we

could practice this rotation indefinitely without worry about organic matter, erosion, and related problems.

But the whole program backfired. On one field serious erosion started at the beginning of the second rotation period and the yield of potatoes was consequently reduced. Fortunately, we had sampled the soil at the beginning of the tests and were able, by analysis, to compare them with samples taken later to determine what had happened. Much to our surprise, most of the plots had lost organic matter at the rate of about 1% of the total supply in the soil each year during the test, although the net change varied somewhat with fertilizer and lime treatments. Perhaps if we had fed the oats and first cutting of hay and returned the manure to the soil the story might have been different.

I cite this instance for two reasons; one is that we made some rather definite statements about such a rotation, since we fully expected that the organic matter would at least be maintained, and further that losses of organic matter when hill land is in potatoes only one year in three may prove serious in the end.

Serious, yes, because organic matter plays such a vital role in soil functions; vital, because it is the source of much of the nitrogen that is going to be available to crops. Because its decay releases phosphoric acid, potash, and trace elements for plant growth and because of the chemical changes it undergoes, soil minerals themselves are acted upon and caused to go into solution and these, too, become a source of nutrients to plants. These things come about not because organic matter is a static substance. It could not possibly be as useful if it were. They occur because, in the soil, it is an ever-changing, dynamic material, imparting this quality to the soil itself.

Even as it approaches, in the end stages of decay, a more or less static condition, organic substance still performs its useful physical and chemical functions. By this time it has reached a colloidal state in which it functions not only in the base exchange complex, absorbing nutrients, holding them until they are utilized by plants but also assists in the build-up of soil structure, causing a rearrangement of the finer soil particles into larger groups making heavy soils more workable, permitting air to enter the soil freely, and enabling water to filter into the soil in greater quantity. Infiltration of water and water-holding capacity are vital points in preventing erosion, erosion which if unchecked will carry away the bulk of this important substance with the topsoil which is most quickly affected.

But why recount all these beneficial qualities of organic matter? They are all well recognized and rarely disputed. What is of much more concern is how the level of organic matter in the soil can be maintained so as to be most propitious for farming.

Climate Most Important

As with many phases of farming, climate not the farmer plays the most important role in determining the amount of organic matter in the soil. Dr. Jenny's work in Missouri exploded many misconceptions on this point. In this work he collected samples of soil from different climatic regions of the United States and analyzed them for organic substance. His main conclusion after his laborious experiment was that nitrogen and organic matter of soils, within regions of similar moisture conditions, decrease from North to South, and that the difference can be calculated mathematically if the climatic factors of different regions are known.

Dr. Jenny undertook his important work, he states, because in the common rotations practiced in Missouri organic matter was not being maintained. His conclusions appear to point to the fact that for each climatic condition and soil group, nature herself tends to maintain the organic matter level at a certain normal point represented by those conditions. Many farming processes work against nature in this respect and

tend to reduce the organic matter supply. This undoubtedly accounts for the very serious erosion and soil depletion that have already occurred in our country and points to the need for rotations and farming practices that will maintain organic matter at such a level that soil structure will be maintained so that water can penetrate the soil and not run off the surface with destructive effects.

Even in our own State, which is 200 miles from north to south, we find a difference in the total stocks of organic matter in the soils, those in the northern part being richer in this respect. Contrast northern New Hampshire and its 100-day growing season with Florida where bacterial activity and organic decay proceed during the whole year! Workers at Gainesville, Florida, told me a few years ago that six weeks after a heavy crop of crotalaria had been plowed under, all traces of it had disappeared, so rapid was its decay there. Professor Stokes stated at that time that soil organic matter was the greatest single disturbing factor to Florida farming and indicated, too, that they had come to the belief that the best farmer was the one who had the most weeds in his corn at the end of the season to form a source of organic matter for the next crop.

Organic Matter Losses

Unfortunately it is much easier to deplete the organic matter than to build it up. Dr. Jenny's work indicates this fact, and the point has been emphasized by other workers. Furthermore, with the climatic or temperature factor in mind, it appears much easier, once the organic matter supply has been reduced, to restore it to the level which represents the norm for the climate, than it is to build it up above that level, for additions over and above that point are subject to undue losses. It is easy to work against nature in one direction, but very difficult to overpower her efforts in the other.

Some idea of the losses that do occur to organic matter after it is applied to the soil may be gained from the work of Salter and Green in which they studied the soils of the long-time fertility plots at the Ohio Experiment Station. In one series of plots, seven tons of manure per acre were applied annually. Over a period of 32 years, 46,400 pounds of organic carbon were applied in the manure, but at the end of that time the soil was richer only by about 5,000 pounds of organic carbon. This represents a loss of nearly 90% of the organic matter of the manure.

However, this isn't a cause for worry, since part of the value of the organic substance lies in the fact that it does decay. The data do serve to emphasize the extremely rapid rate of loss and the handicap under which a farmer works in building up the supplies in his soil.

The same authors present other valuable information on the influence of continuous cropping and rotations in relation to organic matter losses. Corn grown continuously caused the most loss, followed by wheat and oats in continuous culture, while losses in a five-year rotation of corn, oats, wheat, clover, and timothy were slightly greater than in a three-year rotation of corn, wheat, and clover. The slightly better results in the three-year rotation are attributed by these authors to the clover, and they state that it appears better from the rotation point of view to have two crops of clover in six years rather than one crop of clover followed by one of timothy in a five-year rotation.

In all of this work the destructive effects to organic matter with continuous culture to any crop are emphasized, and this fact is well worth repeating to Northeast potato and vegetable growers who attempt rotation practices that even approach a one-crop system. Sooner or later they get into trouble and the nearer the approach to the one-crop system, the sooner it is.

Some work at Illinois which is reported by R. S. Stauffer shows how, under conditions there, the organic

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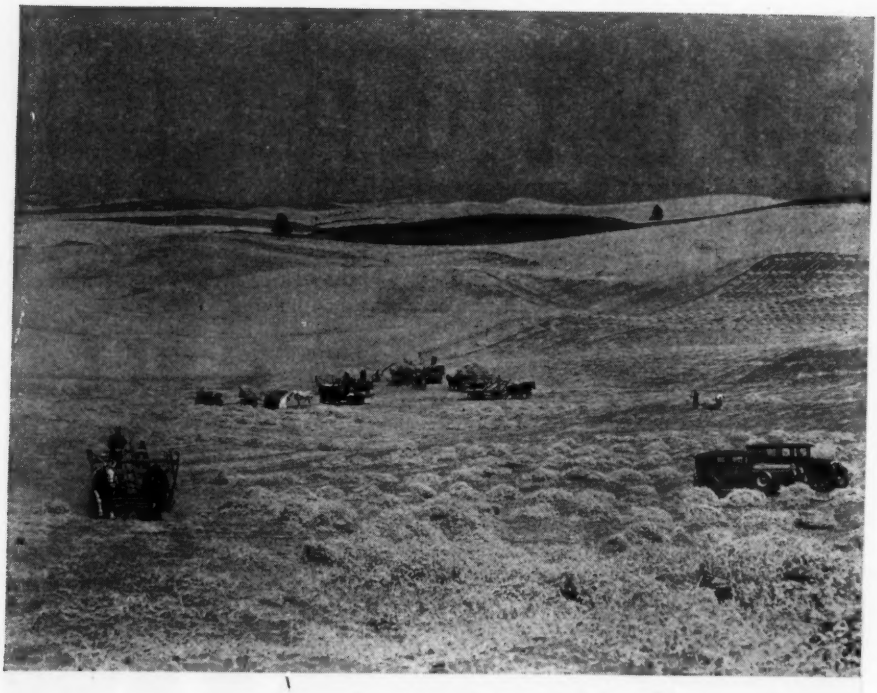
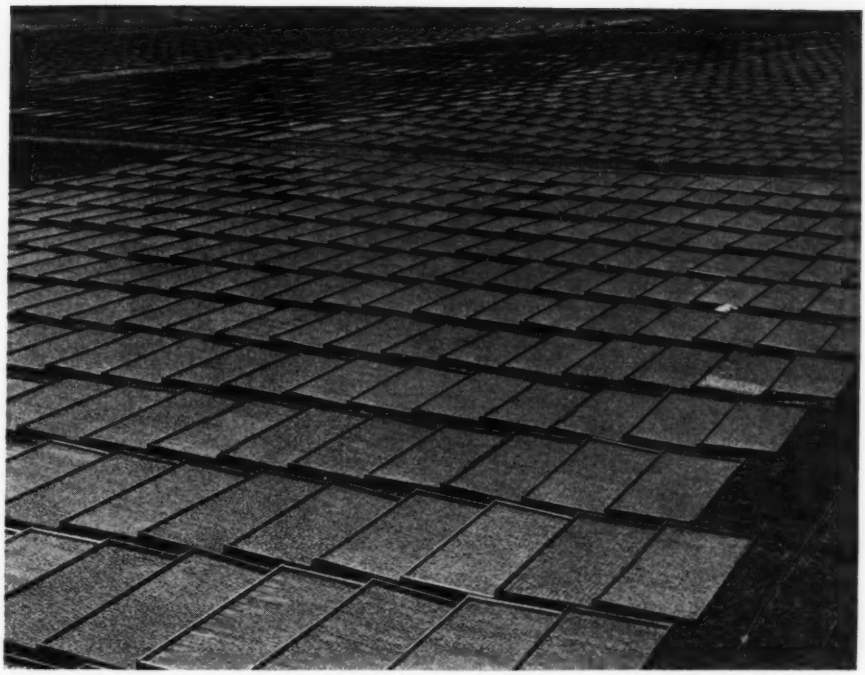
PICTORIAL

AN OPTICAL ILLUSION? NO, THE ROOF OF A BARN.



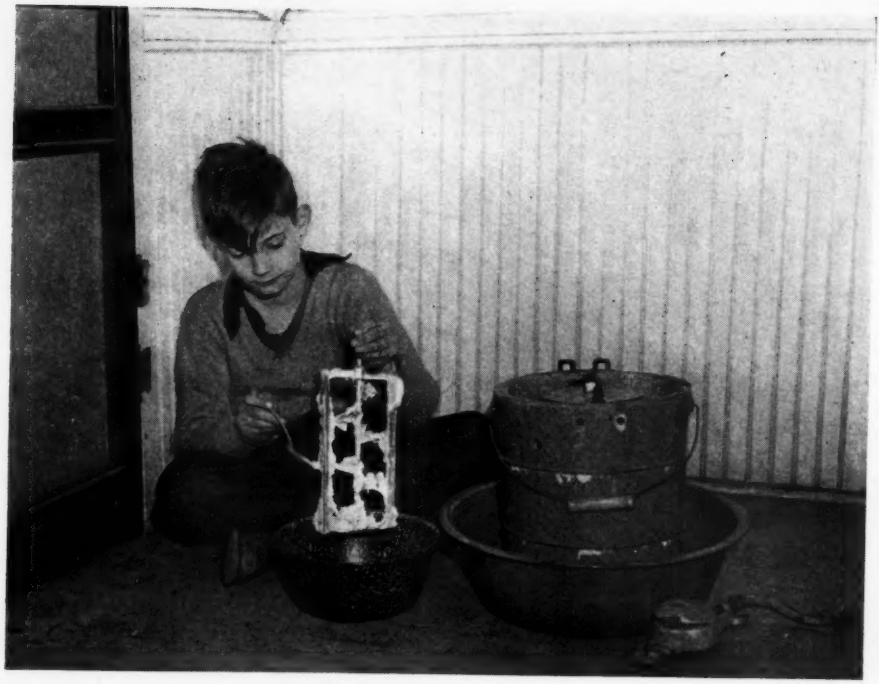
Above: Harvesting peas near Palouse, Washington.

Below: Beans in Michigan—a bulwark of the Navy.



Above: California fruit being dried for packing.

Below: A load of mint—chewing gum in the rough.



Above: It's worth turning the freezer to get the dasher.

Below: Farmers inspecting experiments at Purdue University.

The Editors Talk

A Good Time to Pay Debt to The Soil

Much advice is being given editorially in the agricultural press and elsewhere, to the effect that the present is a most opportune time for farmers to exert every effort to get out of debt. Rising farm prices are creating a strong temptation for farm operators to expand their activities by means of more capital debt. However, the disasters which followed such a course during the last war are still fresh in many minds and form the basis of the caution which is current today.

It was interesting to note that delegates drafting measures for the 1942 AAA farm program, among other resolutions, adopted one to urge farmers to avoid speculative expansion and to reduce debts and build up reserves of cash and farm commodities during the present period of industrial activity and more favorable prices.

R. M. Evans, national AAA Administrator, said in commenting on the recommendations, "That farm families will unselfishly and patriotically contribute to the defense effort of the Nation is reflected in the recommendations for the 1942 program. During the past year, the 6 million farmers participating in the program have found its flexibility useful for meeting new demands for certain kinds of food and fiber, and for meeting new problems brought on by the war. The reserves of food and fiber that farmers have already furnished the Nation in the Ever-Normal Granary, and the suggested changes for 1942 assure the Nation of the same cooperation in the future.

"Agriculture will put the defense effort first. But there is need for agriculture to keep its condition healthy, also. By continuing the emphasis on soil conservation, farmers can meet the demands made on them without waste of soil resources. And by scaling down their debts and maintaining their farm plants in as sound a condition as possible, they will be further adding to the strength of the Nation's defense effort. Through supplies already on hand, by conserving their soil, and by keeping their farming operations sound, farmers are offering to the Nation an agricultural industry that is a strong force for national strength and unity, but also an industry that will be able to meet its problems after the war is over."

In connection with scaling down debts and conserving the fertility of the soil, it would seem that now is also a most opportune time for farmers to be considering paying their debt to the soil. The soil has often been likened to a bank account, and too many farmers for many years have been withdrawing more fertility than they have been replacing. It is not enough to conserve the balance which is now there. That balance may be too low for adequate operation, and some depositing is necessary.

To maintain farm operations in a sound condition will necessitate a careful check-up on the soil bank account and provision to bring as quickly as possible

the fertility balance up to a point where good yields and quality of crops can be assured. Such an investment is sound and in line with the advice and caution which are being given operators. It will be of aid to them not only in meeting the increased demand for farm products but in fortifying themselves for a possible time when this demand subsides, but bills will have to be met just the same.

More Crops Less Acres

The Agricultural Marketing Service of the U. S. Department of Agriculture, in its general crop report as of August 1, had this to say: "Although several crops, particularly barley, beans, rice, some vegetables for canning and probably soybeans, seem likely to exceed previous records, the most notable feature of the crop situation this season is that practically all important crops promise better than average yields per acre. While this has been due in part to abundant rainfall in the Great Plains Area, where droughts in recent years have been most severe, there is increasing evidence that the yields of many crops have been rising as a result of improvement of varieties and use of better equipment and better cultural practices."

From this statement, it is apparent that the use of improved cultural practices is likely to play a very important and significant part in the National Defense Program by increasing the production of crops per unit of land. This involves the use of better varieties, adapted fertilizers properly placed in the soil and used in amounts sufficient for them to exert full beneficial effect, proper mid-season cultural practices, and efficient harvesting, storage, and marketing.

The adoption of these practices is of particular importance to the farmer from the viewpoint of improving his efficiency and thereby increasing the chances of making a profit during a period of rising production costs as well as rising prices for the products he sells. The latter may sometimes cause a grower to overlook the significance of the former and lead him to a sense of false prosperity. Efficiency of production is just as advantageous during times of high prices as during times of low prices.

Another reason for stressing efficiency of production is the farm labor situation, which is becoming a very serious problem in many sections. Increasing the production of crops per unit of land permits a greater utilization of labor, particularly during the planting and mid-season periods. It is in the personal interest of the farmer as well as his duty in the common effort of national defense to utilize all of the known practices which will enable him to produce more and better crops on fewer acres.

"I believe that by the use of extension education more people may be able to get out of the path of future economic disasters. I would suggest that they vigorously seek the truth in terms of advantages and disadvantages, and in this way draw intelligent conclusions. I hold that these conclusions should not be crystallized, but remain fluid and flexible in the face of constantly changing economic conditions. Extension agents have brought and will continue to bring these truths to farmers, leaving to the farmers the course of action to be taken after obtaining a clear conception of the situation."—*Henry A. Wallace, Vice President of the United States.*

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ The results of field and greenhouse investigations of the control of internal breakdown of canning beets by the use of boron are given by G. J. Raleigh, O. A. Lorenz, and C. B. Sayre in Cornell University Agricultural Experiment Station Bulletin 752, "Studies on the Control of Internal Breakdown of Table Beets by the Use of Boron." This internal darkening of beets has been causing great trouble and loss to growers and canners in New York, Wisconsin, Oregon, and other places, particularly in dry years, where the beets are grown on soils alkaline in reaction. Preliminary greenhouse work had indicated that the use of boron compounds would control the difficulty to a large extent, and this bulletin reports results under practical field conditions of applying varying amounts of borax over a period of three years.

In the first year, the relatively moist season prevented the appearance of severe breakdown, although the application of borax tended to reduce what little did appear. The use of 25 pounds of borax per acre did not cause any deleterious effects. In the following years rainfall was less and breakdown was severe in many places where no boron was applied. Small applications of borax reduced the breakdown considerably, but increasing the rate of application to 50, 75, and in a few cases 100 pounds per acre usually further reduced the breakdown. There was not much effect on yield due to the borax applications, and no rate caused any harmful effects.

The application of sulphur for the purpose of increasing the acidity of the soil and thereby possibly rendering more available to plants the native soil boron supply was not very effective, with variable effect on yields and frequent increase in the breakdown.

In order to see whether the boron applications made to beets would be injurious to other crops, red kidney beans, a crop known to be very susceptible to boron injury, were grown on soil which received a high borax application the previous year, and also on soil with a high borax application the same year as seeding the beans. There was no injury to the beans growing on soil which had received 75 pounds of borax per acre the previous year, but the crop was injured by applications of 50 pounds of borax the same year as seeding the beans.

As a result of these investigations, the authors recommend that when beets are grown on soils alkaline in reaction, 50 pounds of borax per acre be applied, preferably by mixing with the regular fertilizer used. They suggest that if a double strength fertilizer such as 8-16-16 is used, the borax be mixed shortly before applying so as to avoid poor physical condition of the fertilizer and possible loss of ammonia. They advise that until more is known of the residual effects of the borax, boron-tolerant crops such as cabbage rather than sensitive crops such as beans should be grown the year following the borax application for the beets.

¶ Those interested in the question of vitamin use of plants will find much pertinent material in California Depart-

ment of Agriculture Bureau of Chemistry Announcement FM-23, "Vitamin B_1 Products Intended for Use on Plants," by Alvin J. Cox. Dr. Cox discusses the occurrence of the vitamin in plants, and quotes numerous authorities on the results of carefully controlled experiments in which Vitamin B_1 was used on plants under various conditions.

¶ "Chemical Composition of Sugarcane Juice as Affected by Fertilizers," U. S. Department of Agriculture Technical Bulletin 754, is a rather detailed and thorough investigation of the effects of fertilizers on the chemical properties of sugarcane juice by Nelson McKaig, Jr., and Lewis A. Hurst. The experimental work was conducted in Louisiana and with fertilizer treatments made according to the Schreiner triangle system. The data represent averages of tests conducted on several commercial plantations. It was found that solids in the juice were increased by phosphate and potash fertilizers; sucrose and purity of juice were increased particularly by potash fertilizer; reducing sugars were decreased by potash fertilizers; phosphate in the juice strangely enough was not increased by phosphate fertilizer, but by potash, while potash and chlorides were increased by potash fertilizers. Many other factors as influenced by fertilization are also reported in this bulletin, which will be of particular interest to those dealing with the growing or processing of sugarcane.

"Evidence of the Value of the Sodium Ion in Cotton Fertilizers," Agr. Exp. Sta., Experiment, Ga., Cir. 127, Apr. 1941, E. D. Matthews.

"Fertilizers for Rice in Texas," Agr. Exp. Sta., College Station, Tex., 730 Prog. Rep., Mar. 17, 1941, A. D. Jackson.

"Fertilizers for Utah Soils," Agr. Exp. Sta., Logan, Utah, Cir. 116, June 1941, D. W. Pittman and D. W. Thorne.

Soils

¶ The use of peat, muck, loam, and similar substances to improve the soil for lawns, gardens, athletic fields, and more recently military establishments is in the aggregate a business running into several million dollars a year. The large use of these materials is due to the fact that a fertile soil necessary for the establishment of a good sward or the production of satisfactory flowers or vegetables is not considered as an important factor in locating dwellings or other enterprises where plantings later are desired. The excavation and grading in building a house usually result in a most unfavorable kind of soil in which to grow plants, while consideration of cost of land and disruption of established life in an area is likely to result in the poorest types of soil being included in military establishments. The addition of ameliorating materials to the soil so as to permit satisfactory growing of plants on such soils within a reasonable time is frequently necessary. Two publications dealing with these materials have recently been issued. Connecticut Agricultural Experiment Station Circular 146, "Loams for Top-Dressing," by Herbert A. Lunt, briefly describes the types of materials that appear on the market under the heading of "loams." Examination of some of the actual materials being sold indicates that almost anything that looks like "rich dirt" may be sold as loam, some sellers apparently innocently foisting off on the unsuspecting buyer material quite unsuited for the purpose intended. The author suggests standards that might be used in selling and purchasing loams, with relative values of different grades. He also gives some idea as to what supplement in the way of fertilizer the loams may need.

The second publication on the subject is "Peat Resources in Alaska," by A. P. Dachnowski-Stokes, issued as U. S. Department of Agriculture Technical Bulletin 769. The use of peat as a soil ameliorant is very common. The source of this peat is partly domestic and, in normal times, partly foreign in origin. This bulletin summarizes the results of a systematic survey of peat deposits in Alaska as a source to supplement the deposits occurring in many of glaciated states and in swampy areas. Many accessible peat deposits were found, and the author feels there is a good possi-

bility of establishing a peat industry in Alaska. He points out some of the problems involved due to local conditions, and also gives a brief discussion of the use of peat as a soil improver, the methods used in exploitation of deposits, and marketing of the product.

"Influence of Colorado River Silt on Some Properties of Yuma Mesa Sandy Soil," Agr. Exp. Sta., Tucson, Ariz., Tech. Bul. 91, June 1, 1941, W. T. McGeorge.

"Soil Survey of the Fredericton-Gagetown Area, New Brunswick," Dom. Dept. of Agr., Ottawa, Can., Pub. 709, Tech. Bul. 30, Nov. 1940, P. C. Stobbe.

"Questions and Answers on Soil Erosion and Its Control in Vermont," Agr. Ext. Serv., Burlington, Vt., Brieflet 584, Jan. 1941, Paul R. Miller.

"Soil Survey, Hall County Georgia," U. S. D. A., Washington, D. C., Ser. 2, Feb. 1941, John T. Miller, Matthew Drosdoff, and G. L. Fuller.

"Hardpan and Microrelief in Certain Soil Complexes of California," U. S. D. A., Washington, D. C., Tech. Bul. 745, Apr. 1941, C. C. Nikiforoff.

"Quality of Irrigation Waters of the Hollister Area of California," U. S. D. A., Washington, D. C., Tech. Bul. 746, Mar. 1941, F. M. Eaton, Roy D. McCallum, and M. S. Mayhugh.

"Better Harvests Through Conservation Farming," U. S. D. A., Washington, D. C., Mar. 1941, R. E. Uhland.

"Conservation Farming for the Sandy Lands of the Southern Great Plains," U. S. D. A., Washington, D. C., Feb. 1941, Tom Dale.

"Conservation Practices for the Range Lands of the Southern Great Plains," U. S. D. A., Washington, D. C., Feb. 1941, J. S. McCorkle and Tom Dale.

"Conservation Farming for the Hard Lands of the Southern Great Plains," U. S. D. A., Washington, D. C., Feb. 1941, Tom Dale.

"Erosion and Related Land Use Conditions," U. S. D. A., Washington, D. C., Sur. 20, May 1, 1941, H. N. Magness and M. F. Sandoz.

Crops

¶ In an unnumbered folder issued by the Purdue University Agricultural Extension Service, entitled "Food for Defense," the importance of employing the most efficient production and management practices for crop and livestock production is brought out. In the field of agronomy, proper corn and pasture fertilization and the conservation of manure and crop residues are stressed. It is suggested that corn be planted on legume sods, manured, and fertilized with 100 to 250 pounds of fertilizer such as 0-12-12, 0-14-6, or 0-10-20. Adequate fertilization and liming of pastures also are suggested.

¶ The emphasis on food production makes several publications on vegetable production very timely. A. G. B. Bouquet has prepared three Oregon Agricultural Extension Circulars numbered 358, 360, and 361, dealing with lettuce, cauliflower, and spinach respectively. In each case, brief and practical information on climatic, soil, and fertilizer requirements, varieties, cultural practices, diseases and pests, harvesting and marketing are given. For lettuce, a 3-10-10 fertilizer in addition to manure is suggested, with additional nitrogen possibly needed in some cases; for spinach, a complete fertilizer and borax in addition to manure are suggested; while for cauliflower, 5-10-7 or fertilizers in a 1-2-1 or 1-2-2 ratio and boron in addition to manure are recommended.

¶ Home gardens in the aggregate represent an important source of foods, and with proper management can be made to produce large supplies on small areas. Growers in Florida and adjacent areas will find much helpful information in Florida Agricultural Extension Bulletin 107, "The Florida Home Garden," by F. S. Jamison. In addition to suggestions on location of the garden, varieties, cultural practices, harvesting and disease control, he briefly makes recommendations on fertilization. He says if large quantities of manure are available, this with phosphate will probably supply the plant food needed. When manure in unlimited amounts is not available, which is likely to be the case with most of the gardeners, a 5-7-5 fertilizer at 2½ to 5 pounds per 100 square feet is recommended.

¶ Tomato growers will find the answers to many of their problems in New Jersey Agricultural Experiment Station Circular 414, "The Answer to Your Tomato Problem," prepared by a committee of experts on the Station staff. The circular is in the form of 102 ques-

tions likely to be raised by the tomato grower, with the answers given for each question. Nearly every phase of tomato growing and handling is touched upon. For the fertilization of the crop under average New Jersey conditions, 1500 pounds of 5-10-10 fertilizer are suggested.

"Fiftieth Annual Report of the Agricultural Experiment Station, 1939," Poly. Inst., Auburn, Ala.

"Fifty-first Annual Report for the Year Ending June 30, 1940," Agr. Exp. Sta., Tucson, Ariz.

"Third Annual Report of the Arizona Fertilizer Control Office, 1940," Agr. Exp. Sta., Tucson, Ariz., Bul. 173, Feb. 1941

"Permanent Pasture Studies," Agr. Exp. Sta., Fayetteville, Ark., Bul. 407, Apr. 1941, Marvin Nelson.

"Newly Developed Vegetable Varieties for Use in California," Agr. Exp. Sta., Berkeley, Calif., Bul. 646, Feb. 1941, D. R. Porter, H. A. Jones, and G. N. Davis.

"Granulation of Valencia Oranges," Agr. Exp. Sta., Berkeley, Calif., Bul. 647, Feb. 1941, E. T. Bartholomew, Walton B. Sinclair, and F. M. Turrell.

"Pear Growing in California," Agr. Ext. Serv., Berkeley, Calif., Cir. 122, Jan. 1941, Luther D. Davis and Warren P. Tufts.

"Foxtail Millet in Colorado," Colo. Exp. Sta., Ft. Collins, Colo., Bul. 461, Nov. 1940, J. J. Curtis, J. F. Brandon, and R. M. Weihing.

"Sugar-beet Growing in Colorado," Colo. Ext. Serv., Ft. Collins, Colo., Ext. Bul. 363-A, Jan. 1941, R. H. Tucker and T. G. Stewart.

"Sixty-third Report of the Connecticut Agricultural Experiment Station, 1939," Agr. Exp. Sta., New Haven, Conn., Pub. Doc. 24.

"General Index for the Year Ending October 31, 1939," Agr. Exp. Sta., New Haven, Conn.

"Agricultural Experiment Station Annual Report for the Fiscal Year Ending June 30, 1940," Agr. Exp. Sta., Gainesville, Fla.

"Comparative Feeding Value of Silages Made from Napier Grass, Sorghum and Sugarcane," Agr. Exp. Sta., Gainesville, Fla., Bul. 358, May 1941, A. L. Shealy, W. G. Kirk, and R. M. Crown.

"Green Feed for Poultry in Florida," Agr. Ext. Serv., Gainesville, Fla., Cir. 59, June 1941, D. F. Sowell.

"Growing Cotton for Profit," Agr. Ext. Serv., Athens, Ga., Cir. 287, Mar. 1941, E. C. Westbrook and R. R. Childs.

"Control of Diseases of Canning Crops in Maryland," Agr. Ext. Serv., College Park, Md., Plant Path. 2, Feb. 15, 1941, R. A. Jehle, H. A. Hunter, and C. E. Cox.

"Seventy-ninth Annual Report of the Secretary of the State Board of Agriculture and Fifty-third Annual Report of the Experiment Station, July 1, 1939 to June 30, 1940, Agr. Exp. Sta., Lansing, Mich.

"Growing Beautiful Lawns," Agr. Ext. Serv., East Lansing, Mich., Ext. Bul. 224, Apr. 1941, James Tyson.

"Establishing Conservation Farming Under the A.A.A.," Agr. Ext. Serv., St. Paul, Minn., Ext. Pamphlet 74, Jan. 1941

"Highlights of the Work of the Mississippi Experiment Station, Fifty-third Annual Report for the Fiscal Year Ending June 30, 1940," Agr. Exp. Sta., State College, Miss., Clarence Dorman.

"An Illustrated Guide to Care of Ornamental Trees and Shrubs," Agr. Exp. Sta., State College, Miss., Bul. 354, May 1941, F. S. Batson and R. O. Monosmith.

"Annual Report of the Board of Control for the Fiscal Year Ending June 30, 1940," Agr. Exp. Sta., Reno, Nev.

"Grape Production in Eastern New Mexico," Agr. Exp. Sta., State College, N. M., Bull. 275, 1941, Donald R. Burnham.

"Annual Report of the Extension Service for 1940," Agr. Ext. Serv., Raleigh, N. C.

"Control of Lawn Weeds and the Renovation of Lawns," Agr. Exp. Sta., Wooster, Ohio, Bul. 619, Mar. 1941, F. A. Welton and J. C. Carroll.

"Korean Lespedeza, the Wonder Clover of Oklahoma," Agr. Ext. Serv., Stilwater, Okla., OP-10.

"Hybrid Corn for Oregon," Agr. Ext. Serv., Corvallis, Oreg., Ext. Cir. 355, Nov. 1940, R. E. Fore.

"Experiments with Buckwheat," Agr. Exp. Sta., State College, Penna., Bul. 403, Mar. 1941, J. W. White, F. J. Holben, and A. C. Richer.

"Fifty-second Annual Report, 1939," Agr. Exp. Sta., Knoxville, Tenn.

"A Hybrid Sweet Corn for Tennessee," Agr. Exp. Sta., Knoxville, Tenn., Cir. 75, Apr. 1941, L. S. Mayer and A. B. Strand.

"Lawn Weeds and Their Control," Agr. Exp. Sta., Logan, Utah, Cir. 117, June 1941, D. C. Tingey and Bassett Maguire.

"Hybrid Corn Adaptation Trials in Wyoming, 1940," Agr. Exp. Sta., Laramie, Wyo., Bul. 246, Apr. 1941, William A. Riedl and W. L. Quayle.

"Blueberries," U. S. D. A., Leaflet 201, Oct. 1940, George M. Darrow.

"Dry Land Crops at the Dalhart (Texas) Field Station," U. S. D. A., Washington, D. C., Cir. 564, Nov. 1940, O. R. Mathews and B. F. Barnes.

"California Farm Handbook, 1941," U. S. D. A., Washington, D. C., 1941.

"North Carolina Farm Handbook," U. S. D. A., Washington, D. C., 1941.

Economics

¶ "'Round the World with Cotton" presents very little that is new about any phase of the cotton industry, but it does accomplish one very useful purpose in that it brings together under one cover a vast amount of interesting information

about cotton. The story is presented in an easy-to-read, non-technical style utilizing photographs, charts, and pictographs to illustrate in an entertaining fashion what has happened in the cotton industry in the United States and abroad since its legendary origin in India some 5,000 years ago. This publication of the U. S. Department of Agriculture, Agricultural Adjustment Administration, was prepared under the supervision of I. W. Duggan, Director of the Southern Division of the Agricultural Adjustment Administration, and Paul W. Chapman, Dean of the College of Agriculture of the University of Georgia. Many persons inside and outside of the Department of Agriculture participated in its preparation.

The subject matter is organized into three main parts. Part 1, "The Story of Cotton," deals with the importance of cotton, the history of cotton, and world cotton crop. Part 2, "Cotton in Foreign Lands," deals with India, cotton in China, Egyptian cotton, the Soviet Union cotton program, cotton in Brazil, and other cotton-producing countries. Part 3, "Cotton in the United States," deals with our Cotton Belt, improving production methods, how cotton is sold, and changes in our cotton trade.

There are more persons in the United States who are dependent upon cotton than on any other crop grown. Nearly 11% or 13,500,000 persons in this country depend directly on cotton for a living. About one-third of the total population in the United States lives on farms where cotton is grown. There are more cotton farms than those of any other single type.

The cotton plant seems to have originated in India where the fiber was grown and spun into fine cloth many centuries before the United States was founded. It was the desire of the people of Europe to secure the treasures of the Far East, including cotton cloth, that led to the discovery of America. At the time of the discovery of America, Columbus found cotton was being grown in the West Indies. Although cotton was planted by the English colonists early in the history of this Continent, it did not become a commercial crop until after the invention of the cotton gin. At first the expansion of the cotton crop came as the result of increased demand from England for cotton to be used in the growing textile industry in that country. For many years the price for cotton was so favorable that people in the South lost interest in the manufacturing side of the industry.

The textile industry in the United States was founded by Samuel Slater who established mills in New England in 1790. The cotton-spinning industry has gradually migrated to the South, and there are now a larger number of active cotton spindles in this section of the United States than in the Northeast.

The world's cotton crop has been increasing markedly for 50 years. It is a warm weather crop and requires a growing season of about 200 days. The world cotton belt lies in general from about 40° north to about 30° south latitude. Although there has been little or no increase in per capita consumption of American cotton at home for a long period of years, the total consumption has increased with the increase in population.

India is favorably located for selling cotton to the countries of the Far East where there is a large population and a growing textile industry, but the quality of Indian cotton is poor. The yields per acre are very low and the farming methods are still primitive. It is difficult to change the Indian methods because of the caste system and as long as this system prevails it is assumed that little change will take place in Indian agriculture. Furthermore it requires a large part of the farm land to provide food for the 375 million people living in the country, thus limiting the acreage that may be devoted to cotton.

The third largest cotton-producing country in the world is China, and prior to the Japanese invasion cotton production was on the upgrade. The Chinese cotton mills are now supplying most of

the cloth used within the country. China has never been an important factor in the world cotton trade but under favorable conditions probably could grow more cotton than is needed at home.

Egyptian cotton is well known throughout the world for its quality. Practically all the cotton grown in Egypt is sold to other countries where there exists an unusual demand because of the long staple which makes Egyptian cotton desirable for certain textiles. Since about 1862 cotton production in Egypt has been expanding. The natural conditions for the growing of the crop are very favorable, but it is pointed out that it is not likely that the expansion in the future will be as great as in the past because food production requires an important amount of available land and cotton must be grown on land irrigated with water from the Nile. It is believed that all of the land suitable for cotton growing is now under cultivation.

In the United States many things have happened in the past 100 years which have favorably and unfavorably affected the position of the United States in the world cotton trade. Since about 1920 domestic sales of cotton grown in the United States have been fairly constant but sales to other countries have fallen off. All exports have declined, but agricultural commodities have declined more than industrial products. Since foreign trade is largely an exchange of goods, the United States must accept goods in return for those which it has to sell. This country has many products to sell but few are acceptable in return. At the present time there exists in the world what is termed a saturated cotton market, which means that there is being produced as much cotton as can be sold. It is impossible to predict the future cotton requirements of the world or the quantity of cotton grown in this country which can be sold at home and abroad.

"Commercial Fertilizers and Agricultural Minerals, 1940," Dept. of Agr., Sacramento, Calif., Spec. Pub. 183.

"Commercial Fertilizer Sales as Reported to Date for the Quarter Ended March 31, 1941," Bur. Chem. Anns. FM-22, Dept. of Agr., Sacramento, Calif., May 21, 1941.

"Citrus Production Costs, 1940," Agr. Ext. Serv., Berkeley, Calif.

"The Fertilizer Trade in Canada, July 1, 1939-June 30, 1940," Dept. of Trade and Commerce, Ottawa, Can., W. H. Losee.

"Statistical Information Pertaining to The Marketing of Agricultural Products in Connecticut, 1940," Dept. of Agr., Hartford, Conn., June 1941, Ann Bushman and Sylvia Gruskin.

"An Economic Study of Land Utilization in New Castle County, Delaware," Agr. Exp. Sta., Newark, Del., Bul. 228, Feb. 1941, R. O. Bausman.

"State Laboratory Fertilizer and Seed Report, July-Dec. 1940," Bd. of Agr., Dover, Del., Quarterly Bul., Vol. 31, No. 1.

"Agricultural Planning and Its Economic and Social Aspects," Agr. Exp. Sta., Bozeman, Mont., Bul. 391, June 1941, Carl F. Kraenzel and O. A. Parsons.

"Fertilizer Regulations," Dept. of Agr., Raleigh, N. C., July 1, 1941.

"North Carolina Fertilizer Law," Dept. of Agr., Raleigh, N. C.

"A Special Assembly of Agricultural Statistics, State of Oregon," Agr. Ext. Serv., Corvallis, Oreg., Ext. Cir. 357, Dec. 1940.

"Amendment to Fertilizer Act., Gen. Assembly of Ohio, Columbus, Ohio, House Bill 390.

"Facts About National Defense and the Farmer," Agr. Ext. Serv., Columbus, Ohio, Facts Ser. 31, Apr. 1941.

"Triple-A Tools for Better Farm Living," Agr. Ext. Serv., Clemson, S. C., Cir. 191, Mar. 1941.

"Vermont Rural Families Face Defense Conditions," Agr. Ext. Serv., Burlington, Vt., Briefet 599, June 1941.

"Farm Management for Soil Conservation in the Harrison Area," Agr. Exp. Sta., Morgantown, W. Va., Bul. 301, May 1941, Everett C. Weitzell.

"Corn Futures, Volume of Trading, Open Commitments and Prices from January 2, 1936, to December 30, 1939," U. S. D. A., Washington, D. C., Stat. Bul. 74, May 1941.

"Changing Technology and Employment in Agriculture," Bur. of Agr. Econ., U. S. D. A., Washington, D. C., May 1941, John A. Hopkins.

"Loans to Farmers and Ranchers—1940," F. C. A., U. S. D. A., Washington, D. C., Cir. A-22, Apr. 1941.

"Trends in the Consumption of Fibers in the United States, 1892-1939," U. S. D. A., Washington, D. C., Apr. 1941, Robert B. Evans and Rose F. Monachino.

"Production, Disposition, and Value of Citrus Fruits, Crop Seasons 1909-1910—1938-39, by States," U. S. D. A., Washington, D. C., May 1941.

Better Pastures for North Mississippi

(*From page* 19)

actual grazing of animals, but this requires more uniform and level lands than are available at Holly Springs. To this time, small plots repeated often and the use of scales and chemical analyses appear to be the most practical way. Under the skillful direction of H. W. Bennett, Pasture and Forage Crops Specialist of the main station, assisted by the local management of the Holly Springs station, much research work is being done that should throw light on the pasture problems of this section as a whole, especially on the millions of acres of eroded and partially eroded lands of Marshall and adjoining counties of Mississippi and Tennessee.

The pasture crops that have so far done best at Holly Springs are carpet, bermuda and paspalum grasses, with white and hop clovers and lespedeza among the legumes. However, all sorts of combinations of these and other grasses and clovers not so commonly grown are being tried experimentally, all fertilized in many different ways with results so far showing the preponderant need for mineral fertilizer. It might be well to state that as newly cleared lands the soils here were never so deficient in plant nutrients as in many other soil types of the State. For many years after they were brought into cultivation these lands were cropped fairly successfully, except for erosion, without the use of fertilizers under the common farm crops. However, as a result of some 36 years' work in fertilizing all kinds of farm crops at the Holly Springs station, the evidence is conclusive that commercial fertilizers of the proper analysis, in field and pasture, return just as good profits here as they do on other soil types of Mississippi which have never been cultivated without first applying fertilizers.

Cages over 39 pasture fertilizer plots at Holly Springs—summer 1940.

The Effect of Borax on Spinach and Sugar Beets

(*From page* 14)

the intake of nitrogen by the plants.

To verify the conclusion that an application of borax had caused a reduction in the nitrogen content of beets and had possibly affected other constituents, samples were gathered from the areas not treated with borax and from the treated areas and were analyzed for boron, iron, and nitrogen by the methods already described.

According to the data reported in Table 2, an application of borax increased the boron content and decreased the percentage of nitrogen and iron in the dry tissue of the beet roots. As already stated, Schmidt (12) found that sugar beets starved for boron allowed nitrates to enter in such quantities as to become toxic and cause the death of the cells. If this is true, the nitrogen content of the soil might be expected to have some effect on the seriousness of the physiological disturbances and, therefore, on the yield.

With this problem in mind a pot culture experiment was set up in which sugar beets were grown on Thomas sandy loam soil variously treated with respect to boron and nitrate nitrogen. The soil used was known to be deficient in boron available to sugar beets. As shown by the data reported in Table 3, applications of ammonium nitrate reduced the yields of sugar beets in pots which received no borax but increased them in pots which received borax. In other words, where available boron in the soil was low, additions of nitrate seemed to make the condition for growth of beets still worse. This is shown by the decrease in yield of roots from 32.6 to 29.2 grams per pot. This difference is not large but appears to have been actually caused by the nitrate. In contrast to this reduction in yield on pots not treated with borax, the nitrate caused an increase in yield of 2.9 grams per pot on those which received 10 pounds of borax per acre and an increase of 7.1 grams per pot on those which received 20 pounds of borax per acre. That available boron was actually low in this soil is shown by the average increase in yields following an application of borax where no nitrate was applied. The 10-pound application of borax increased the yield from 32.6 to 34.9 grams, while the 20-pound application resulted in a yield of 39.2 grams per pot. The duration of

TABLE 2. THE EFFECT OF BORAX ON THE BORON, IRON, AND NITROGEN CONTENT OF SUGAR BEETS GROWN ON WISNER SILT LOAM SOIL IN 1940

Treatment	Composition of root tissue dried at 65° C		
	Boron	Fe_2O_3	Nitrogen
	P.p.m.	*Per cent*	*Per cent*
No borax	11.8	.011	1.51
Borax, 20–40 lb. per acre*	19.0	.005	1.01

* Applied as a side-dressing after the beets were blocked. Samples for the analyses were taken at random from plats which received borax at the two rates. The analytical data represent averages from four separate samples.

the experiment was 84 days. Had it been allowed to run longer, perhaps the increases in yield would have been larger.

The fact that the increased nitrate content of a soil low in available boron was injurious to sugar beets seems to verify Schmidt's (12) conclusion that breakdown of the tissue was due to toxic concentrations of nitrate in the cells. If this were true, however, one might expect greater differences than were found in the total nitrogen content of the dried tissue.

Another explanation for the relationship between nitrate and boron is indicated by the data on boron reported in Table 3. Where borax was not applied the nitrate applications resulted in a decrease in the boron content of the dried beet tissue. The differences, 3 p.p.m. with the first application of nitrate and 7 p.p.m. with the larger application, were very marked. Perhaps a deficiency of boron allows more nitrate to enter the plant, but also an excess of nitrate may hinder the intake of boron. This might help to explain the observation often made and recently reported (6) that heart rot of sugar beets is often serious on soils extremely high in organic matter. Perhaps the effect of organic matter cannot be entirely laid to its combination with boron to form an unavailable compound, but partly to the fact that it is a source of nitrate which may inhibit boron intake by the plant.

Further reference to Table 3 shows that the calcium content of dried beet tissue was unaltered by the borax applied but was slightly affected by the nitrate applications. Higher nitrate applications seemed to result in plants lower in calcium. The magnesium content of the beets grown on pots treated with borax was slightly higher (ranging from 0.24 to 0.50 per cent) than of those grown in pots which did not receive borax. The effect of nitrate on the magnesium content of the beets was not consistent.

Fig. 5. Spinach leaves. Those on the left from a boron-starved plant. The one on the right from a normal plant.

Fig. 4. A spinach plant suffering from boron starvation. Note the numerous small, deformed leaves. The petioles were roughened, crooked, and twisted. These symptoms closely resemble the leaf symptoms on sugar beets.

There appears to be a definite relationship between the presence of boron and the absorption of iron. The percentages of iron reported in Table 3 show that as the available boron content of the soil was increased by the addition of borax, the iron content of the plants decreased. The average concentration of iron was about one-half as great in the plants treated with 20 pounds of borax as in those not treated. This relative difference is just about equal to that caused by a similar application in the field on Wisner silt loam soil. Further reference to Table 2 shows

TABLE 3. THE EFFECT OF NITROGEN AT DIFFERENT LEVELS OF AVAILABLE BORON ON THE YIELD AND COMPOSITION OF SUGAR BEETS GROWN IN POT CULTURES OF THOMAS* SANDY LOAM SOIL

Treatment		Yield per pot	Composition of roots dried at 65° C				
Borax	NH_4NO_3 equivalent to		Boron	Fe_2O_3	Nitrogen	CaO	MgO
		Gm.	*P.p.m.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
None	None	32.6	13	0.036	1.10	0.32	0.24
None	95 lb. NO_3 per A	30.6	10	0.020	1.21	0.30	0.34
None	190 lb. NO_3 per A	29.2	6	0.020	1.14	0.26	0.38
10 lb. per A	None	34.9	16	0.018	1.02	0.33	0.40
10 lb. per A	95 lb. NO_3 per A	37.2	17	0.011	1.13	0.29	0.47
10 lb. per A	190 lb. NO_3 per A	37.8	15	0.026	1.21	0.28	0.40
20 lb. per A	None	39.2	18	0.010	0.98	0.39	0.50
20 lb. per A	95 lb. NO_3 per A	41.7	20	0.010	0.98	0.32	0.49
20 lb. per A	190 lb. NO_3 per A	46.3	20	0.009	1.09	0.33	0.44

* An alkaline soil high in organic matter and known to be deficient in boron available to sugar beets.

that beets grown in the field without borax applied contained 0.011 per cent iron, while those treated with 20-40 pounds of borax contained only 0.005 per cent iron. In beets grown in the field as well as in the greenhouse higher boron concentrations were accompanied by lower concentrations of iron.

Very little has been written about the needs of spinach for boron. Hartman (9) reported that spinach seedlings failed to develop normally on soil on which cauliflower had developed boron deficiency symptoms. He found that many of the first true leaves were small and deformed and that many of the plants turned yellow and died at an early stage. The roots of affected plants turned black.

Experimental results have shown that spinach plants do not grow normally when the level of available boron is too low. It is impossible at present to say just what this level should be, but it seems that on soil where sugar beets develop heart rot, spinach will also show symptoms of boron starvation. These symptoms are in many ways similar to those of heart rot.

Spinach planted on May 5 was ready to harvest by the end of June and at that time had developed marked symptoms of boron starvation. The plants, as a whole, were flattened, with the leaves tending to spread out in a horizontal direction rather than to

Fig. 6. Spinach plants, treated with borax at the rate of 80 pounds per acre on the left and untreated on the right. The roots of the treated plants were healthy and widespreading while those on the boron-deficient plants were restricted, deformed, and blackened.

stand erect as in a normal plant. Many of the center leaves were small and deformed as shown in Figs. 4 and 5. There seemed, also, to be a greater number of small leaves, as if the failure of the leaves to reach normal size had stimulated the plant into production of a greater number. Individual leaves were twisted, apparently as a result of faster growth on one side than on the other.

At harvest time the plants on plats not treated with borax were much smaller and were of a light green, almost yellow, color. They appeared also to be less succulent.

It was noticed that the roots of the plants on the plats which did not receive borax were very much restricted, as compared to those of normal plants, and were dark colored, resembling the roots of sugar beets suffering from heart rot. A comparison of healthy spinach roots with those of plants suffering from boron starvation is shown in Fig. 6.

An application of 10 pounds of borax, broadcast before planting, increased the yield of spinach from 8.1 to 14.3 pounds per plat (Table 4). The difference is highly significant and within 0.4 pounds of that obtained as a result of applying 20 pounds of borax. The rates of application of borax in the experiment ranged from 10 to 80 pounds. There was no advantage in applying a quantity greater than 10 pounds per acre. While no attempt was made to record differences in quality, it was noticed that very little of the spinach on the plats which did not receive borax was marketable.

To gain further information on the role of boron as a regulator of nutrient intake, dried spinach tissue was analyzed for boron, iron, nitrogen, calcium, and magnesium.

As shown by the data reported in Table 4, the boron content of spinach tissue grown without borax treatment was very low, both in tops and roots.

TABLE 4. THE EFFECT OF BORAX ON THE YIELD AND COMPOSITION OF SPINACH GROWN ON THOMAS SANDY LOAM SOIL

Treatment	Rate per acre	Yield per plat	Chemical composition of tissue dried at 65° C								
			Boron		Fe_2O_3		Nitrogen		CaO		MgO
			Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots	Tops
	Lb.	*Lb.*	*P.p.m.*	*P.p.m.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
3–12–12 [1]	500	7.3	5.8	6.2	1.320	0.084	4.23	2.85	1.75	1.48	3.20
No borax	0	8.1	5.6	5.2	1.370	0.091	4.29	3.08	1.87	1.17	3.16
Borax	10	14.3	11.6	10.2	0.082	0.086	4.26	2.64	1.79	1.32	3.28
Borax	20	14.7	15.2	11.0	0.091	0.095	4.33	2.71	1.71	1.34	3.11
Borax	40	13.1	20.2	12.0	0.089	0.090	4.31	2.87	1.84	1.14	3.28
Borax	80	14.5	32.2	15.0	0.095	0.097	4.38	2.63	1.82	1.42	3.29
F value		14.1**	45.5**	9.83**	3.85*	3.00	3.07	3.13	3.31	1.20	1.93
Required for significant difference between means		2.6	4.4	3.4	0.038	0.031	0.27	0.29	0.39	0.46	0.30

[1] This treatment did not include borax or any plant nutrient other than N, P, and K. The materials applied in all other treatments were uniform except for borax, and included the following materials applied as pounds per acre at the rate indicated: 3-12-12, 500; NaI, 0.5; $ZnSO_4$, 4.0; $MgSO_4$, 25.0; $MnSO_4$, 25.0; $FeSO_4$, 2.0; NaCl, 10.0; $CuSO_4$, 5.0.

* Significant to 5% point.

** Significant to 1% point.

In fact, the content was lower than has usually been found in sugar beets exhibiting heart rot in its most severe stages. The 10-pound application of borax resulted in a significant increase in the boron content of both tops and roots, and larger applications of borax had the effect of still further increasing the concentration of this element in the plants. The increase was quite consistent with all applications of borax, and the parts per million of boron in the tissue as a result of the 80-pound application of borax was greater than in sugar beet tissue subjected to similar treatment.

The application of borax caused a decrease in the iron content of spinach tops and in the nitrogen content of spinach roots. Both of these differences were significant, but no differences were found in the iron content of the roots or in the nitrogen content of the tops.

The calcium and magnesium contents of spinach grown in this experiment were not altered by the applications of borax. Very slight differences were obtained in the results of the analyses and none of them proved significant.

In discussing the work of Brandenburg (2), Dennis and Dennis (7) report that boron is not translocated from old to new portions of a plant but that a constant supply is at all times necessary. Brandenburg found that when the source of boron supply was interrupted the new leaves of sugar beets were very low in content of boron while the older leaves, formed while the supply of boron was plentiful, retained the normal amount of boron. He reported further that the new leaves, formed under inadequate supply of soil boron, soon developed symptoms of boron deficiency.

The fact that boron, once fixed within a plant, is not readily translocated to other portions of the plant or to the new tissue makes the problem of fertilization with boron much more interesting and important. It also makes it more difficult and probably accounts for the fact that the appearance of boron deficiency symptoms seems to have some correlation with weather conditions.

Sugar beets and spinach (Chenopodiaceae—goose foot family) are very closely related plants. This fact probably explains why the symptoms of boron starvation are almost identical in the two plants and why both plants are so seriously affected by a shortage of available boron in the soil.

Boron Content Increased

As already mentioned, spinach tissue grown on a boron-deficient soil was lower in parts per million of boron than was sugar beet tissue, but it is interesting to note the increase in content of boron in both crops, both tops and roots, with applications of borax to the soil. Brandenburg (3) has reported that roots of sugar beets having heart rot were as high in boron content as were normal beet roots, but that in the leaves of beets with heart rot the boron content was much lower than it was in the leaves of normal plants. Work in this laboratory shows that greater differences in boron content may occur in the leaves but that very significant differences may occur also in the roots.

The fact that applications of borax cause such marked increases in the boron content of sugar beet and spinach tissue seems to indicate that boron must have some function within the plant and that it does not act entirely as a regulator of the intake of other ions by the roots.

There seems little doubt, however, that boron does have some effect on the intake of nitrogen and iron. This observation has been made by several investigators as respected nitrogen, but so far as the writers are aware nothing has been written regarding iron. As indicated by the data already reported in this paper and by other determinations made in this laboratory and not yet reported, the reductions in iron content of dry plant tissue as a result of additions of borax to the soil are more marked than are reductions in nitrogen content.

It has been suggested that the physiological breakdown of plant cells which accompanies boron starvation is actually caused by too high a nitrate concentration in the cells and not because of lack of boron to build the tissue. This is probably true, but it may also be true that nitrate nitrogen may decrease the permeability of the root membranes to boron and thus cause such a low concentration of boron in the plant tissue as to actually cause the breakdown. This result was indicated by some of the data reported in this paper.

If nitrate nitrogen in toxic concentration is a factor in the physiological disturbance caused by lack of boron, perhaps iron is also a factor, the death of the cells being due to too high an iron concentration. This is probably not true, however, because of the low solubility of iron compounds. In the absence of sufficient boron, iron probably enters the roots and is translocated to different parts of the plant where it is fixed into relatively insoluble and nonmovable forms, perhaps as ferric iron.

Summary and Conclusions

Sugar beets grown in the field on alkaline silt loam soil were side-dressed with borax applied at rates of 20 and 40 pounds per acre, respectively. Heart rot occurrence and yields were measured in the field and dry tissue from field-gathered samples was analyzed for sucrose, boron, nitrogen, and iron.

Sugar beets grown in greenhouse pot cultures were treated with two respective quantities of ammonium nitrate at different levels of available boron. Yields were determined and quantitative tests made for boron, nitrogen, iron, calcium, and magnesium in the plant tissue.

Spinach was grown in the field on alkaline sandy loam soil known to be deficient in boron for sugar beets. Yields were measured and analyses made for boron, nitrogen, iron, calcium, and magnesium contents. From the results of these experiments the following observations may be made:

1. Borax, applied at the rate of 20 pounds per acre as a side-dressing on Wisner silt loam soil, reduced the number of beets bearing symptoms of heart rot from 96.86 to 11.36 per cent and increased the yield from 7.16 to 14.30 tons per acre. The application increased the size of the individual roots from 0.93 to 1.79 pounds. The borax application caused an increase in percentage of sucrose from 14.11 to 18.02 and in the percentage purity from 80.92 to 84.91. An application of 40 pounds per acre produced slight but not significant increases over those resulting from the 20-pound application.

2. Borax, applied broadcast for spinach at the rate of 10 pounds per acre before planting, prevented the appearance of boron deficiency symptoms and caused an increase in yield from 8.1 to 14.3 pounds per plat. Larger applications of borax (20 to 80 pounds) did not prove toxic but did not cause further increases in yields.

3. The boron deficiency symptoms in spinach were found to be almost identical with symptoms of heart rot in sugar beets. This is not surprising since the two plants are very closely related in the plant kingdom.

4. Applications of borax increased the boron content of the dry tissue of sugar beet roots and of spinach roots and tops. This increase was highly significant.

5. Applications of borax reduced the nitrogen content of sugar beet and spinach roots. This result was indicated by a decrease in the percentages of soluble substances other than sucrose in the juice of sugar beets and by nitrogen determinations on the dried tissue of both plants.

6. Ammonium nitrate, applied to pot cultures of Thomas sandy loam, a soil low in available boron, caused a decrease in the boron in dried sugar beet root tissue.

7. Applications of borax caused a decrease in the percentage of iron in the dry tissue of sugar beet roots and spinach tops. The differences were even

more marked than were the differences in nitrogen content.

8. In the case of sugar beet root tissue grown in one pot culture experiment, borax was found to be the cause of an increase in percentage of magnesium in dried tissue. In the spinach, magnesium was not altered by the borax applications.

9. Borax had no effect on the calcium content of either spinach or sugar beets.

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Organic Matter Conceptions and Misconceptions

(*From page* 22)

matter level fluctuates with different cropping and fertilizer systems in comparison with land in permanent sod. In this report, continuous corn, without fertilization, was the worst offender, but losses in organic matter occurred even when corn grown continuously was manured, limed, and fertilized with rock phosphate. In an unfertilized three-year rotation of corn, oats, and clover, losses occurred, but where this rotation was manured, limed, and fertilized, the organic matter level was raised above that of nearby sod land. Stauffer found a direct correlation between the organic content of these soils and their water-holding capacity.

Wheeting's work in Washington points to manuring and fertilizing as being important in building up the stocks of organic soil substance. In this work, rotation or farming land was compared with stump pasture or cut-over land which had been subjected to slash burning. In two comparisons, one of which concerned itself with a manured rotation and the other in a heavily-fertilized, vegetable-growing system, the organic content was higher in the cropped than in the nearby pasture or cut-over land, while in the third rotation system in which fertilizers or manures were not used, the organic content was lower after many years of farming than in nearby cut-over land. Manure and fertilizers that increase crop residues do, of course, tend to counteract the depleting effects of cropping systems.

With all the emphasis that is being placed upon pasture top-dressing in the Northeast, it is interesting to note the

effect of fertilizers upon the organic matter content of sod land. Seitz, at the Virginia Polytechnic Institute, reports a study of pasture soils top-dressed with 200 pounds of 16% superphosphate annually since 1917 and 1933 respectively, and in comparison with untreated sod land these soils gained 95% and 55% in organic matter. This denotes an increase of roots in the soil, and such increase would undoubtedly be in fairly direct proportion to the pasture yields. Any system of top-dressing, therefore, which increases pasture yields will probably show a gain in soil organic matter, and in the Northeast, in most locations, a complete fertilizer would give quicker results than superphosphate alone. This excellent report causes us to wonder how much the depleted organic matter supply of these old pasture soils is responsible for low forage yields where the land has been untreated for a long time.

Seitz also finds a direct correlation between organic matter and soil structure, noting an increase of 21% in water-stable soil aggregates in the soil treated since 1917 and a 19% increase in that treated since 1933. The fact that the increase in water-stable aggregates is not in direct proportion to the increase of organic matter probably indicates that the optimum conditions for structure development are reached long before the soil reaches its possibilities in relation to organic content as affected by treatment.

Smith, Brown, and Russell have investigated organic content in relation to infiltration capacity and they conclude that soils high in organic matter may have an infiltration rate double that of soils with a low organic content. This infiltration capacity of the soil has been shown by many workers to have a direct bearing on erosion, since the amount of water that runs off a field is directly responsible for erosion and conversely, the more that soaks into or infiltrates into the soil, the less erosion will occur.

In view of this fact, it is easy to see why soils cannot be farmed to cultivated crops indefinitely without erosion troubles, and apparently that is what has happened over a wide area in the United States, explaining the reasons why our attention is focused upon erosion today more than ever before.

And now, before I stop, I want to make some of those definite statements I spoke of in the beginning, for it seems to me, in spite of the need for more information, some of the facts in relation to organic matter are quite apparent.

One of these is that crop rotation in and by itself does not supply an adequate method of maintaining organic matter. Manuring, liming, and fertilizing, with a suitable rotation of crops, will tend to maintain or increase it.

One-crop System Harmful

Except for permanent grasses and clovers, there is no one-crop system that will maintain organic matter. Continuous cropping to corn, potatoes, or other cultivated crops will almost certainly deplete the organic matter supply and cause erosion and other soil troubles. Continuous cropping to small grains is not so destructive of organic matter as continuous corn, for example, but even these crops require other soil-building processes if organic matter is to be maintained.

Even with sod crops, such as are found in permanent pastures, an effort must be made to maintain fertility if the organic supply is to be kept up. Good hay crops, with their bulky residues and root systems, tend to conserve organic matter in a rotation in which they are included. This serves to emphasize one of the good and one of the bad points of New England and Northeastern farming. Long rotations, in fairly fertile hay fields (and especially on dairy farms where abundant manure is used on the land), tend to conserve organic matter. But the long neglected pastures have undoubtedly suffered because of depleted organic supplies, since no adequate effort has been made to build up their fertility.

With all these facts in mind it would seem that the potato and vegetable

growers of New England have on their hands a difficult problem of maintaining organic matter. And many of them know it because of the accelerated erosion they are now encountering. Some of them have already been forced to construct terraces and adopt contour farming practices and other methods of combating erosion. Even with these aids, yields of crops will suffer without organic maintenance, hence longer rotations with sod crops, the use of more land to spread out their operations, and the adoption of green manuring practices are indicated. Some growers may even court the idea of keeping a few cows.

Even with practices that are entirely desirable, natural forces come into play to prevent a build-up of organic matter above the norm for the climate and soil. Fortunately for the Northeast, this norm is relatively high anyway, and when farmers learn to approach it, less trouble will be experienced. But trouble does occur here just the same as it does in the Midwest and South when soils are mismanaged.

Cotton and Corn Response to Potash in South Carolina

(*From page 9*)

about knee-high. All the fertilizer was applied under the crop in the Coastal Plains soils except for a split application of nitrogen, with 1/4 under and 3/4 to the side when the corn was knee-high.

The results from these experiments are shown in Tables 2 and 3.

It will be noted in Table 2 that either the nitrogen or phosphorus or a combination of the two gave a decided increase in yield. These experiments indicate that most of these rather fertile bottomland soils in the mountain sections will respond to high rates of a high nitrogen-phosphorus treatment. From general observations it has been noted that an occasional field will give response to potash. The custom in many of the mountain sections of South Carolina has been to apply a sack (200 pounds) of superphosphate per acre with no nitrogen or potash added.

TABLE 2.—RESPONSE OF CORN TO FERTILIZER
(Mountain Soils of South Carolina)
Average of Five Years

* Treatment		Average yield in bushels of shelled corn per acre	Response per cent of no potash
No Fertilizer	0–0–0	36.4	.....
No Nitrogen	0–10–7.5	38.0	.....
No Potash	8–10–0	49.9	100.0
15 lb. of K_2O	8–10–3.75	49.8	99.8
30 lb. of K_2O	8–10–7.5	49.4	99.0
45 lb. of K_2O	8–10–11.25	50.5	101.2
60 lb. of K_2O	8–10–15.0	50.6	101.4
75 lb. of K_2O	8–10–18.75	48.8	97.8
90 lb. of K_2O	8–10–22.5	49.2	98.6

* Rate—400 pounds per acre.

TABLE 3.—RESPONSE OF CORN TO FERTILIZER
(Coastal Plains Soils of South Carolina)
Average of Four Years

* Treatment	Average yield in bushels of shelled corn per acre	Response per cent of no potash
No Fertilizer.....0–0–0.....	14.1	.....
No Nitrogen.....0–10–7.5.....	17.7	.....
No Potash.....8–10–0.....	20.9	100.0
15 lb. of K_2O.....8–10–3.75.....	24.8	118.7
30 lb. of K_2O.....8–10–7.5.....	27.1	129.7
45 lb. of K_2O.....8–10–11.25.....	27.7	132.5
60 lb. of K_2O.....8–10–15.0.....	28.0	134.0
75 lb. of K_2O.....8–10–18.75.....	29.7	142.1
90 lb. of K_2O.....8–10–22.5.....	31.9	152.6

* Rate—400 pounds per acre.
All phosphorus and potash applied under the crop.
¼ of the nitrogen under the crop and ¾ as a side application.

Table 3 indicates a decided response of corn to potash on the more sandy Coastal Plains soils. Calculated with the no-potash yield as 100 per cent, the various rates of potash with 15-pound increments to a high rate of 90 pounds of K_2O per acre gave a 52.6 per cent increase in yield of corn. There were indications that the nitrogen and phosphorus in the fertilizer mixture gave a like response, that is, corn treated with a complete fertilizer more than doubled the yield over plots receiving no fertilizer. On the Coastal Plains soils tested, to be assured of a satisfactory yield of corn, a complete fertilizer was almost essential in all the experiments averaged.

In conclusion it should be pointed out that an average of a large number of experiments with cotton on a number of South Carolina soils shows a profitable response to high rates of potash. A more critical analysis of individual experimental data indicates the sandy soils and in some cases clays cropped to legumes give the greatest responses. Time of application was not essential on these experiments.

The response of corn to potash on a number of South Carolina soils has been somewhat varied. The mountain bottomland soils tested gave little response, while an average of results from Coastal Plains soils gave a marked response. An analysis of individual experimental data indicated that corn was not as exacting as cotton in its requirement for potash on most soils. A complete fertilizer seemed essential for the proper development of corn.

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Good Farming By Good Neighbors

(*From page* 16)

tilizer so that it can grow fast and set a heavy crop of high quality peppers. Both he and his neighbor use 500 pounds per acre of a 6-11-6 fertilizer in which a high proportion of organic materials is used. This is applied as a side-dressing by a machine distributor which places the fertilizer about five to six inches from the plants and four inches deep. The peppers are given from four to six irrigations during the season, as they have a relatively high water requirement. They are subject to attacks of aphis and pepper weevil, and this latter pest sometimes requires three dustings with calcium arsenate. Frost and winds may reduce this crop considerably.

Sugar beets follow the pepper crop. Residue of each crop in the rotation is plowed into the soil, and in the case of the sugar beets, Mr. Peukert is convinced that the effect carried over from the complete fertilizer applied to the pepper crop or other crops is very considerable. The sugar beet is a good "rustler" for plant food and gets much benefit from this residual fertilizer. He has observed that the beets growing on this land, fertilized the year before with the 6-11-6 mixed fertilizer, were fully equal to beets fertilized with a nitrogen fertilizer.

Speaking of nematodes, a pest which causes no end of trouble on many crops, not only in Ventura County but in many sections of California, these men say that they have left the nematodes behind. With crop rotation and plenty of nitrogen, phosphorus, and potash for the crop to feed upon, the nematodes do not seem to catch up!

You have probably guessed right that the kind of farming done by Peukert and Arrougé has been a paying proposition. Last year Peukert hung up a county record on his sugar beet crop—a yield of 27 tons per acre. The beets averaged a little over 17½% sugar. His exhibit of beets and chili and pimiento peppers took first premium at the County Fair. Peppers on these two

This is the field of sugar beets that made 27 tons per acre.

farms yield about 6 tons per acre, and now the lima bean yield is 25 sacks per acre.

Farming sense, a neighborly spirit, plus drainage, crop rotation, cover crops, and fertilizers have made that first picture of alkali land and crop failure recede far into the distance. In the future this kind of farming will have to be applied to many California farms. Peukert and Arrougé, the good neighbors, are just a little "ahead of the procession."

Vitamins—the V-Sign

(*From page* 5)

also gets into a peck of trouble sometimes. Maybe if the case is more in his mind than in his metabolism, the patient with the drug-store habit will get relief just because he can take something night and morning. Why, this same relief was afforded long ago in the days of Bosh's Bitters and Lydia Pinkham's pellets.

I knew a drug-store dyspeptic who tried to reform his bowels and blood stream by proprietary advice and frequent reading of everything about vitamins he could find in scientific literature. He was convinced that the main cause of his botheration was B—vitamin B complex, if you know what I mean. I'm afraid I don't. But see what he found.

PERUSING the technical descriptions of the signs and symptoms of B complex in various classes and subclasses, this addict was more confused than ever and got worse fast.

"External symptoms are observed in man and animals which suffer from riboflavin deficiency. These include cheilsosis, glossitis, and keratitis. Use 200 to 300 micrograms per 100 grams of ration.

"Nicotinic acid is a component of cozymase and coenzyme No. II. An inadequate supply causes pellagra. It is needed in larger amounts than other B vitamins, namely two or three mg. per 100 gm. of a ration.

"In connection with the use of pyridoxine it is found that rats on a diet of sucrose, purified casein, salt, thiamin, riboflavin. and vitamins A and D, will grow well for a week and then plateau, with typical acrodynia.

"The following factors are included in the B complex: thiamin, riboflavin, nicotinic acid, pyridoxine, choline, inositol, biotin, factor W, and alkaline labile factors for dogs, factor R and factor S and chondroitin. If all these are needed in human diseases the future of B vitamins seems tremendous."

When I last saw him he was begging for more new discoveries and borrowing money on his life insurance policy to buy more pills and fortified foods. He wondered if he could cure himself before he died of old age and why.

Yet on the whole we may happily conclude that if one doesn't take it too seriously and let homeopathic vitamin dosing get him down, the results are at least harmless. It beats trying to drown out sorrow with alcohol anyhow.

There was another lad sliding into just such a bad state of mind over vitamin deficiency and home treatment who got a job working on a farm to help an uncle in an emergency. After pitching hay in the hot sun, cultivating corn behind a lame horse, milking a dozen cows twice daily, and eating threshermen's meals afterwards, the fellow returned and pitched out all the vitamins in his select stock. Somehow the sunshine and tired-man vitamins cured him without more advice from the soda counter. He can eat dill pickles, ice cream, and salt pork all in one meal now and not feel deficient of anything.

Speaking of summer, by the way, I have always been interested in the apparent connection which exists between

the process called "photosynthesis" in plant tissues to make chlorophyl and the action of sunlight on body tissues in health promotion. This mode of absorbing vitamins by skin exposure has caught my daughter along with many other tender young plants. How they love to bask quite bare in the garden behind the house, taking in the vitamins that otherwise would have to be absorbed through spinach and such disagreeable tidbits. If sound health can be had by dermal sun bathing, I shall be the last to discredit the process, as it often improves the scenery along main street. But I wish they would fry themselves evenly.

They claim likewise that the dairy cow chewing her cud in summer on lush green meadows partakes of vitamin surplusage and strains the best of it through her mammary system into the milk bucket, so much so that summer milk is prized above that produced when icicles on the pump interfere with the winter's watering process.

Yet after we have removed the errors due to mistaken zeal from all this vitamin therapy as practiced by the average citizen, it is surely a sign that science has become a real factor in our lives. Folks listen nowadays to the pronouncements of the laboratory more than they did when we were young. It means that scientists have a larger place and a bigger field in which to operate for human welfare. If nobody paid much attention to their discoveries, it would mean just filling a few more old library shelves with cluttered documents.

IT PUTS the biological scientist in a ticklish place. He needs just enough stimulative publicity to aid him in securing enough funds in this critical time with which to continue his research; but if he overplays his hand on half-truths or makes premature announcements about the newer knowledge of nutrition and vitamin cures, he is sure to be misquoted and cause endless confusion and contradiction. So when I find one of the better informed men of the food laboratory reticent about explaining more than he is sure of, I respect his wishes and quit trying to obtain a scoop. The publicist likewise shares the responsibility for leading the hungry public to the best menus.

Doubtless the other side of the picture in the future development of better nutrition will be that relating to improvement in the common foods now making up the usual American diet. The restoration of vital chemical elements in those foods and perhaps the fortification of others with vitamins will soon become the mainstay in nutrition.

In this to some extent already farmers and soil workers play a vigorous and important part, but as time passes and further new facts on the interplay of those chemical regulators appear, I believe that there will be more opportunity for the production of better raw materials containing more vitamin ingredients to the ton.

THE doctors and analysts are busy trying to find out more definitely what amounts and how often the human body needs certain vitamin chemical factors to maintain good health and poise. While this work proceeds and the biological scientist assays more foods to find out their present vitamin content and how it varies under changes in temperature in cooking, I expect that there will be a corresponding movement on the land side to give the producer a part in shaping this vitamin picture.

Studies in summer milk and carotene in hay making and in grass silage have already become known and utilized to marked advantage. I therefore look to the agricultural horizon for more partnership with science in the future welfare of mankind.

Until that day comes may your vitamin intake be at the optimum, and your winters be as rosy and hopeful as the warm and invigorating season we now adjourn. But get your vitality at the table and in action, rather than over the prescription desk. It will make the V-sign stand for something lasting on this side of the globe, far richer than a military victory for us all.

"Miss Epsom," said the colored parson impressively, as he led her into the brook for baptism, "I'se gwine lead you out inter dish heah stream, an' wash out every spot o' sin you's got."

"Lawsy, Pahson," giggled the erstwhile frolicsome damsel, "in that li'l ole shallow creek?"

Too Young

"Why aren't you in school, my little man?"

"Hell, lady, I'm only four."

"Boy!" said the grasshopper as it hit the windshield, "I'd like to try that again but I haven't got the guts."

A doctor received a call late one night and on a lonely road quite a ways in the country his car broke down. The only life he could see was a light in a home in the distance. He walked to the house and rapped on the door. A very beautiful young woman appeared. He explained his plight and asked if he could stay all night. She explained that she was a widow and lived alone, had only one bedroom, but that she would be glad to let him have it, and she would sleep on the lounge. He went to the room, took off his clothes, and went to bed. He had been there only a short time when the door opened slightly and a soft voice inquired: "Are you asleep?" He answered, "No." "Would you like to have a bedfellow tonight?" "Yes," he replied. "All right," she responded, "Another man's car has broken down and he wants to stay here tonight also, so I'll send him in."

"Hot dog! Last night I finally persuaded my gal to say that little word, 'Yes.' "

"Congratulations, old man. When's the wedding?"

"What wedding?"

Oh, mother may I go out to swim?
Why not, my darling daughter,
You're so damned near naked anyhow
You'd look better in the water.

On visiting his parish after an air raid, a minister asked an old Scottish lady how she conducted herself when Nazi bombs were falling around, and this is what she said:

"When the air raid warning sounds, I tak the Guid Book from the shelf and read the 23rd Psalm where it says 'Though I walk through the valley of the shadow of death I will fear no evil, for Thou art with me.' Then I put up a wee bit prayer. Then I tak a wee drap o' whiskey to steady me nerves. Then I get into bed and pull up the covers; and then I tell Hitler to go to hell."

Down at a Southern camp, a colored outfit, just drafted, was lined up before the clerk for preliminary questions.

Clerk: "Name and address?"

Rastus: "Sakes alive, suh? Yo' ought to know. Yo' all sent fo' me."

And—

Our idea of an optimist is a man who took the marriage vows at the ripe old age of 90 and started house hunting for a home close to a school.

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